THE
ELECTRICAL REVIEW.

VOL. LIX. SEPTEMBER 28, 1906. No. 1,505.

ELECTRICAL REVIEW.

Vol. LIX.] CONTENTS: September 28, 1906. [No. 1,505.

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Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

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A DISAPPOINTMENT IN STATISTICS.

WHEN a promise is 12 months old, one expects that its fulfilment will, at least, justify the effluxion of the intervening time. Yet the manner in which the Board of Trade, in their annual railway returns for the United Kingdom issued last week, have given effect to the promise made last year leaves much to be desired. The general report which precedes the pages of tabulated matter states:—"Additional returns have been obtained for 1905 from railway companies whose lines were worked wholly or in part by electricity. These returns show that at the end of 1905 the length of line, in equivalent of single track, which was worked *solely* by electricity, was 140¼ miles; while that worked *partly* by electricity was 170½ miles. The returns further show that the number of miles run by electrical trains in 1905 was 9,667,429, including 9,640,921 miles by passenger trains, 2,870 miles by goods trains, and 23,638 miles by mixed trains; and that the total quantity of electrical energy used in 1905 for electrical train running and other purposes was 100,977,467 Board of Trade units."

This is bald enough in all conscience. Turning to the additional statistical matter, and also delving into other sections of the report, a few further features can be elucidated. Appendix D gives the length of line over which electric trains were run during 1905, the number of train and car-miles travelled, and a census of rolling stock on certain railways. Finally, we have the already quoted figure of the "quantity of electrical energy used for traction and other purposes in Board of Trade units" (100,977,467 units) for all the railways lumped together. What could be cruder? There ought to have been furnished a statement of the units generated; the units used for lift and signal operation and lighting; the balance, which would include units used on the trains and lost in conversion and distribution; these should have been stated in each case, and should have been allocated per car-mile and per train-mile.

The introduction of the car-mile unit is one mercy for which we must be thankful. It is all to the good that we have the intelligible car-mile unit in place of the unintelligible train-mile unit. But why not an introduction of the passenger-mile unit? Except in the case of the inclusive 2d. fare for any distance on the Central London line, this could and ought to have been afforded.

The following total figures are of interest: Total length of track mileage for lines worked solely by electric traction, 140¼; total length of track mileage for line worked partly by electric traction, 170½; total train mileage of electric trains conveying passengers only, 9,640,921; number of electric locomotives in service, 66; number of electric motor-cars carrying passengers (excluding motor-cars running on roads), 550; number of cars, other than motor-cars carrying passengers, 838. The total car-mileage cannot be given because the Metropolitan Railway has not supplied this information, but for individual lines the following figures may be quoted:—

Line.	Equivalent number of car-miles travelled.
Central London	8,874,891
City and South London	4,412,631
Great Northern and City	1,985,390
Lancashire and Yorkshire	4,428,505
Metropolitan District	4,407,222
North-Eastern	3,680,266

An examination of other parts of the returns enables the compilation of a few other figures, some not directly set out, but easily deducible, these being—

Line.	Train-miles travelled per route-mile of track.	Earnings per train-mile from passenger traffic.	Earnings per car-mile from passenger traffic.	Working expenditure per train-mile.	Working expenditure per car-mile.
Central London ...	212,755	65·31	9·37	35·80	5·14
Great Northern and City ...	186,987	37·37	13·97	20·70	5·78
City and South London ...	155,190	31·56	7·77	15·93	3·90

For the foregoing figures to be in any way comparable, it is required to know the weight of each train or vehicle unit, together with the average number of passengers carried per mile run.

No figures are given as to earnings from electrically-operated trains on the North-Eastern, Lancashire and Yorkshire, or Metropolitan and Metropolitan-District lines. A deficiency of this kind is certainly disappointing in a Government official return. We hope for its rectification in the future.

Scarcity of Fuel for Suction Gas Plants.

The recent successful development of suction gas plants using anthracite coal has led to such a great demand for the particular sizes of that coal known as "peas" and "beans"—for the use of which these gas plants have been more especially developed—as to cause the prices to rise considerably.

"Peas" and "beans" were, until this development of the gas engine plant, the forms of anthracite for which there was not so great a demand; this naturally encouraged manufacturers and inventors to develop apparatus capable of utilising these sizes of anthracite coal in preference to any other.

Anthracite coal has always sold at a good price, and the demand for a variety of special purposes such as malting, stoves, &c., is now rapidly increasing; this naturally forces up the prices, so that the outlook for the owners of suction gas producer plants designed for this fuel is anything but hopeful as regards the possibilities of cheap power.

All the anthracite collieries are about as fully developed as they can be, and it requires a large output to produce even a few trucks per day of the smaller sizes such as "beans," while the cost of production also keeps creeping up; so prices are likely to remain firm for some time, as the demand seems to have overtaken the supply.

During the past week fancy prices have been paid by the owners of those plants which had run short of coal, and who had, therefore, to obtain it at any price or shut down.

Orthography and Telegraphy.

It would appear that the spelling reform in the United States and the International Telegraph Convention are not quite in agreement. The telegraphic point of view, like many others, appears to have entirely escaped consideration. It was stated in a London daily paper that great excitement was caused at the American Embassy by the receipt of a dispatch composed of words in the new form. How was the telegram charged for by the telegraph companies? According to existing rules of charging, proper English words must not be mutilated. We think the use of the new form of spelling will either be prohibited—at any rate, we hope so—or the words so written will be chargeable as code, and should a word of more than 10 letters appear in a plain language telegram written in the new style, it will rank as two. It would appear that before words in accordance with the new spelling reform can be made use of, the new system will have to receive authorisation from a conference.

The friction, predicted in our columns as likely to occur between the telegraph companies and the public with regard to counting and charging, has already caused great annoyance, as could only be expected from a system such as that permitted by the London Telegraph Conference, and we are brought again to our old recommendation of charging per letter, and allowing the public to send whatever they like. This should cause no insurmountable difficulty to the various telegraph companies so long as it is agreed to by the various administrations that are parties to the convention.

The Trees on the Embankment.

The L.C.C. is in trouble once more. The Embankment tramways are being laid, and someone wrote to the *Times* on the 13th inst. to protest against the use of double-decked cars on them, chiefly because the trees then must be cut back, and, secondarily, for the reason that they are ugly in themselves. "Why should these huge cars be used? Why not the small cars of Milan, Turin, Zürich, Madrid, in fact, of almost everywhere?"

To him in the succeeding issue calls the secretary of the Metropolitan Public Gardens Association. He is quite rude to the electric cars of London, calling them lumbering, noisy, and ill-ventilated structures, and hopes that everyone who cares for the preservation of trees in London will bring pressure to bear on the Council to use only single-decked cars.

The contemplated damage is not confined to the branches, which will be cut away to the trunk for a height of 16 ft. to 18 ft. from the ground, but extends to the roots, which are even now endangered by excavation and by rough treatment. The Association could not believe until work had begun that the Council would excavate up to within 2 ft. 6 in. from the kerb, so the secretary's protest comes late.

We hope we shall not be accused of taking *any* stick to beat the Council, if we offer the Public Gardens Association our sympathy in this matter. The people of London—nay, the people of the civilised world—are reaping benefits which this Association has sowed, and they would lose no small thing if the Embankment avenue were to be destroyed.

There is nothing to be said against the tramway scheme, as such, for the whole body of British expert opinion—and that is an opinion in the forming of which the British public exercises a vast, if unseen, power—is in favour of double-decked cars; and, unless the lines are to be used for express service only, as, of course, they are not, they must be placed as near the pavement as possible, if the maximum convenience of passengers and the minimum risk to them are to be studied. This arrangement is of particular importance on such wide thoroughfares as the Embankment.

Probably the L.C.C. has had enough of single-decked cars in the Aldwych subway, and it would be difficult to persuade it to save the branches by running another special service with that kind of car; but the cause both of the roots and branches might be served by moving the position of each track a few feet nearer the centre of the roadway. That would mean a single line of independent traffic between the cars and the kerb, which is no more than all the passengers will have been accustomed to, as the outer rail of almost every tramway in the kingdom is laid at least 9 ft. 6 in. from the kerb, and passengers have to look out for themselves when alighting from the cars.

We could not recommend the tracks being moved any further towards the centre than this, as a double line of independent traffic would be really dangerous, but we see no reason why the L.C.C. should not bow so far to the wishes of the majority.

It is unfortunate that the Gardens Association or some other representative body did not think of safeguarding the trees while the Council's Bill was yet unpassed.

Pole Lines.

Where all wires are aerial and uncovered, as in the greater part of North America, the problem often arises in what order the various circuits are to be placed on the one pole which seems to serve for all. The question receives comment in a recent issue of the *Street Railway Journal*, and the writer expresses the opinion that the high voltage wires, which ought to be the strongest, should go on the top, and so on down to the telephone and signal wires on the lowest arm, unless it is more convenient to put these just above the local lighting circuits.

The calm way in which are carried on one pole circuits varying from 30,000 volts three-phase A.C. to 600 volts D.C., and telephone wires, is likely to amaze the unsophisticated Briton, who is accustomed to bury each circuit decorously in separate conduits underground, and we do not think for a moment that the authorities ever will permit such a mixture here, nor should we think it fit for them to do so, doubtless on account of our narrow insular minds.

"On a very high voltage line, say from 30,000 to 60,000 volts, it is a grave question if the wisest plan is not to build a separate transmission line well beyond the reach of the low potential circuits."

No one has insisted more strongly than ourselves that aerial transmission and distribution lines are essential to the prosperity of the mines and factories of this country, as without them no power scheme of large extent can flourish, but we never carried our suggestions to the length which is accepted as common practice in America.

If many serious accidents had been caused by these methods, we cannot believe that the tone of the article under consideration could have been so matter-of-fact and placid, so we are bound to think that they have been successful; in which case we have another object lesson to demonstrate the fact that high-tension overhead transmission can be carried out without the elaborate precautions deemed necessary in this country.

Municipal Tramways Association.

The proceedings at the Conference which concluded last Friday were noteworthy for the earnest and business-like discussions which took place, and which, with the papers, we are reporting at considerable length. We may draw special attention to two of the papers—namely, those of Councillor Smithson and Mr. Holford—which deal with subjects of the first importance, and set forth views which for the most part are, in our opinion, sound commonsense. Councillor Smithson, whose experience of tramway matters in Leeds goes back to 1892, in his shrewd comments on certain features of municipal management, unwittingly supplies weighty arguments against municipal trading in this connection; for the practices which he condemns are rather the rule than the exception. In this, as in other aspects of the subject, we call for fair and impartial treatment of the interests of all the ratepayers, and such doings as the construction of tramways along unremunerative routes to satisfy local cliques (with the fear of the elections before them), the undue increase of ½d. fares (which seldom, if ever, cover the cost of transport), and the charging of street widenings to other accounts instead of to the tramway for which they were undertaken, are each and all the outcome of injustice and unfair dealing. On the question of the depreciation fund, we would go further than Councillor Smithson, and, with Mr. Holford, demand that proper provision should be made for this inevitable need, before any contribution whatever is made to the relief of the rates or other purposes alien to the tramways undertaking. We were pleased to note that this view was strongly supported by the members; the paper and discussion will be reported in our next issue.

Regarding the thorny subject of brakes, the most prominent feature of the discussion, which we report in this issue, was the divergence of views held by the members. On only one point did they approach agreement—namely, in opposition to Mr. Mozley's conclusions; and so far as the latter supported the use of some form of track brake, the sense of the meeting was in his favour. We may recur to the subject in the future, contenting ourselves at present with the remark that the whole question of braking needs thorough investigation by some authoritative and impartial body.

It will be noted with regret that the question of amalgamation of the three tramway associations has been definitely shelved for the present; but we hope it will be brought forward again at a future date with a happier result.

A METHOD OF COMPARING THE EFFICIENCIES OF ELECTRICITY GENERATING STATIONS.

By C. J. Evans.

When it is desired to compare different stations as to their economy or efficiency as a whole, tables of statistics are consulted which generally contain a column headed "Cost of coal per Board of Trade Unit (pence)." This ratio, however, is of practically no value for the purpose, because the cost of transport of the coal per ton varies so much for different stations, according to their distances from their collieries, that this variable cost quite masks their true economy; consequently only stations using coal giving the same thermal effect per unit of cost can be compared by means of this ratio.

A somewhat less unsatisfactory ratio for the purpose is "Pounds of coal per Board of Trade Unit;" but this does not take into account the quality of the coal, and when it is remembered that the calorific value of steam coal varies from 10,000 to 15,000 British thermal units per pound, it will be seen that this ratio is little, if any, better for the purpose, and that it can only be used to compare stations using coal of the same calorific value.

A much more satisfactory basis on which to found comparisons between any stations using any quality of coal is "British Thermal Units per Board of Trade Unit."

For example, in the case of a station consuming 7 lb. of coal having a calorific value of 14,000 British thermal units per pound—per Board of Trade Unit:—British thermal units per Board of Trade unit = 98,000.

This can also be expressed as what may be called the "Thermal Efficiency" of the station, which may be written—

$$\frac{\text{British Thermal Units in Electrical Energy}}{\text{British Thermal Units in Coal Consumed}},$$

or more conveniently,

$$\frac{\text{British Thermal Units in a Board of Trade Unit}}{\text{British Thermal Units in Coal consumed per B. of T. Unit.}}$$

One Board of Trade Unit being equivalent to 3,414 British Thermal Units, in the above example the "Thermal Efficiency" $= \frac{3{,}414}{98{,}000} = 3{\cdot}48$ per cent.

Even this basis of comparison is not strictly just, since a station using a poorer coal will have to handle a greater weight for a given thermal effect than one using a better coal; in a small station the difference in weight will not generally involve an addition to the staff, but in a larger one the coal handling plant will require rather more power, though in either case the difference thus made will be only a very small proportion of the total cost; and it does not allow for different load-factors and such considerations. Nothwithstanding these objections, however, either the ratio "British thermal units per Board of Trade unit," or the "thermal efficiency" provides a very equitable basis on which to compare the economy and efficiency of different stations, since neither depends on the cost of the coal, the cost of its transport, or on its quality—these varying greatly with different stations—but only on the actual quantity of heat dissipated.

This principle could also be applied to steamships for the same purpose.

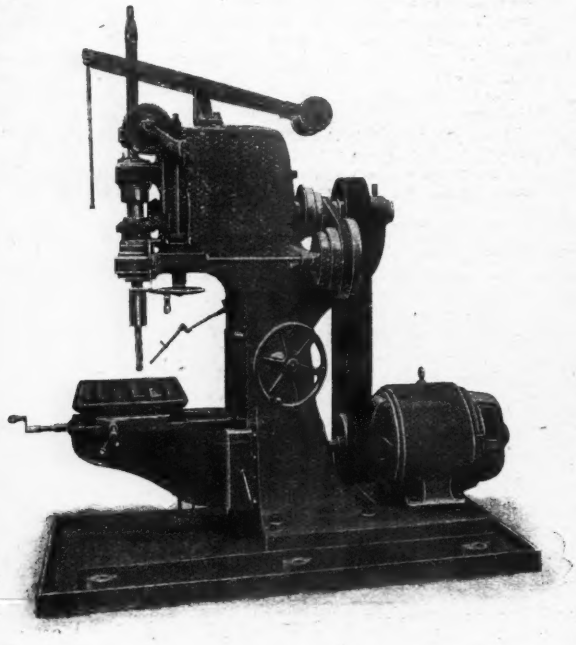
THE ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

(*Continued from page 453.*)

Sir W. G. Armstrong, Whitworth & Co., Ltd.

This well-known company exhibits two electrically driven tools, viz., an 18-in. lathe and a vertical drilling machine; also a variety of standard taps, dies and gauges. The machines, which we illustrate, are intended to demonstrate the capacity of the company's high-speed tool steel, for both turning and drilling.

The lathe, which will admit 10 ft. between the centres, is driven by a 3 to 1 variable-speed motor. The fast headstock is fitted with a steel spindle running in parallel gun-metal bearings, and the gear-wheels are machine cut from the solid and have helical teeth. The saddle is fitted with back and front rests. This lathe is capable of taking a cut $1\frac{1}{2}$ in. deep $\times$ $\frac{1}{4}$ in. traverse at 30 ft. per min., and will allow of speeds from 30-400 ft. per min. The feeds are from $\frac{1}{16}$ in. to $\frac{1}{4}$ in. per revolution.



Electrically-operated Drilling Machine.

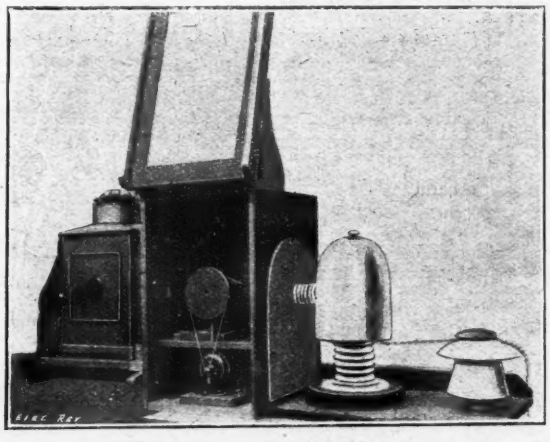
The vertical drilling machine has a 9-in. downward traverse. This machine is driven by a belt from a 3 to 1 variable speed motor, and has feeds of 35, 50, 80 and 120 cuts per in. The spindle is balanced, and on the release of the clutch it falls back into the topmost position. A lubricating pump is also fitted.

W. H. Allen, Son & Co., Ltd.

Messrs. Allen are showing high-speed engines, air and centrifugal pumps, &c, all of which are familiar to our readers. The larger engine is of the three-crank compound high-speed vertical enclosed type, capable of developing 450 B.H.P., and a smaller 220-B.H.P. two-crank compound engine of the same type is on view. The air pump is of the three-throw "Edwards" type, suitable for dealing with 20,000 lb. steam per hour; and the centrifugal pumps, in several sizes, are of the popular "Conqueror" type.

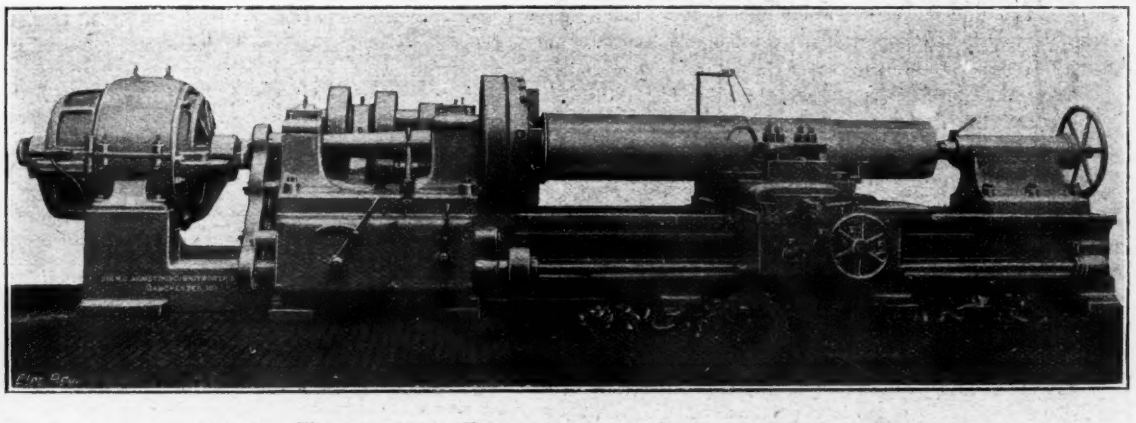
The Cambridge Scientific Instrument Co., Ltd.

The apparatus exhibited by this firm is primarily designed for the use of engineers, more especially those who are directly or indirectly interested in the measurement of temperature. An interesting feature is the recording of the temperature in the steam plant of the Exhibition; the thermometers being placed more than 500 ft. from the recording instrument. These thermometers consist of copper-constantan couples suitably protected in steel tubes, one being inserted into the steam pipe leading from the superheater, and the other in the feed-water pipe; they are connected by means of leads to the patent thread recorder on the stand. The electromotive force generated by the thermo-electric couple is measured by the deflection of a galvanometer coil which carries a boom, the latter being depressed once in every minute on to the paper wrapped round a clock-driven drum. The boom when depressed forces an inked thread on to the paper, leaving a small ink mark behind it.



Duddell Oscillograph for H.T. Work.

The Féry radiation pyrometer, which was recently described in the Electrical Review, will be used in the Exhibition to measure the temperature of a small gas muffle furnace. It is proposed to heat samples of steel in this furnace, and to take their points of re-calescence by means of a resistance thermometer connected to a Callendar electric recorder.



Armstrong-Whitworth 18-in. Electrically-driven Lathe, for High-Speed Work.

A model of a section through a hot-air main, showing the method of inserting and protecting the thermometer, is exhibited. The Whipple temperature indicator for use with a resistance thermometer, giving a very open scale, is also shown. This instrument has been found useful in boiler trials, general test work, &c.

Amongst other new instruments we may mention Murday's patent pressure recorder, the patent recording mercury thermometer and a speed variation chronograph.

The pointer Duddell thermo-ammeter is similar in principle to the now well-known Duddell thermo-galvanometer, with the exception that the coil of the galvanometer is mounted on pivots instead of a delicate quartz fibre suspension. The instrument has no self-induction, and may be used on either direct or alternating current, being entirely independent of the frequency.

A Duddell oscillograph designed for high tension work is exhibited. In this oscillograph the magnetic field is produced by means of a strong permanent magnet, so that the only connections necessary on the oscillograph are those from the vibrating systems to the circuit to be investigated. It is thus easy to insulate the instrument effectively. In the outfit illustrated, this insulation is provided by placing the oscillograph on a tall corrugated porcelain

insulator. It has also a porcelain cover, while the possibility of brush discharge to the case is further provided against by having a large porcelain plate between the instrument and the case. Behind the oscillograph there is a large high tension insulator for the purpose of supporting the leads to the oscillograph. With this outfit circuits of high potential, up to 30,000 volts, may be safely studied. All the working parts are enclosed in a strong metal case which has iron pole-pieces let into the sides to concentrate the magnetic field. This case is filled with the damping oil, and is also provided with a cover. The two vibrating systems are also quite distinct from each other, and can be removed independently for repair. As each vibrating system is made as simple as possible no special skill is required to repair it, any reasonably skilled experimenter being able to re-suspend it complete in about a couple of hours. Anyone who has endeavoured to re-suspend vibrators of the high-frequency type will realise what a great improvement Mr. Duddell has introduced in this new single simple vibrator.

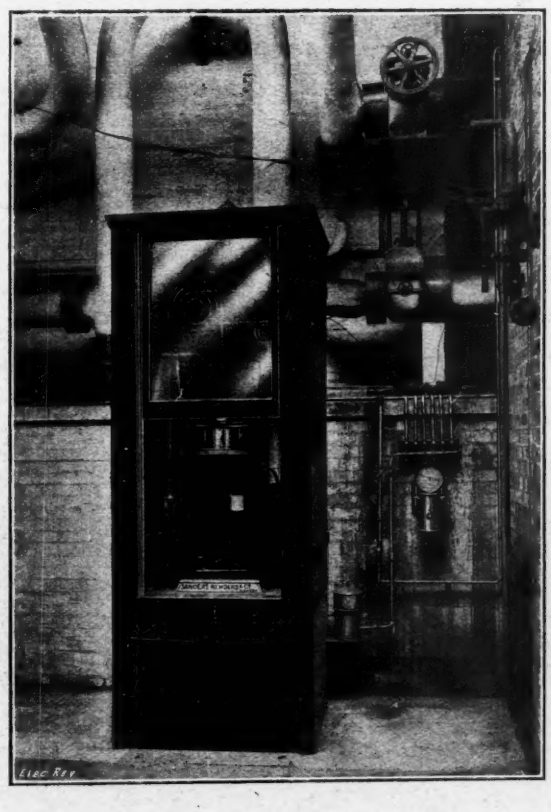
There is also besides the usual screw adjustment of the spots in azimuth, another adjustment by which the whole vibrator can be tilted through a small angle so as to bring the spots into the same horizontal plane.

In the Rosenhain calorimeter for determining the calorific value of fuels, the novel feature is the adaptation of absorption pellets for absorbing oils of which it is desired to measure the calorific value. The calorific value of some coal will be taken at the Exhibition.

Sanders, Rehders & Co.

The feature of Messrs. Sanders-Rehders' stand is undoubtedly the "Sarco" automatic CO_2 recorder, very familiar to the central station engineer under its old name "Ados." The apparatus is so well known, and has been described so frequently, that we may simply point out that it is proving an invaluable means of ensuring the maximum efficiency of combustion in the boiler house.

It can with advantage be combined with the same firm's "Phœnix" recording draught gauge, an instrument which enables



An Installation of the "Sarco" CO_2 Recorder and Draught Gauge.

the stoker to adjust his dampers so as to ensure the right quantity of air entering the furnaces.

The dial gauge contains a bell floating on glycerine enclosed in the body of the instrument, which is in communication with the outside atmosphere; a tube enters at the bottom of the instrument, and is carried under the bell. The lower open end of this tube is connected with the boiler flue by means of a gas pipe. The draught from the chimney creates a partial vacuum under the bell, and the latter is forced down by the atmospheric pressure on it. This motion is transmitted accurately to the dial by means of a small circular rack, fitted to the bell, and a pinion.

The recorder attachment consists of a drum which carries a chart for 24 hours, and is fitted with a seven-day clock movement. Our illustration shows an installation of the CO_2 recorder and draught gauge for automatically recording the results of combustion in six water-tube boilers alternately, each boiler's performance being recorded over two-hour periods.

In addition to the above, the firm has on view other boiler house instruments which have a direct bearing on efficient operation.

Thus the "Sarco" steam load meter is claimed to indicate the correct quantity of steam generated at any instant by a boiler; and this, of course, enables the stoker to ensure that each boiler is working at its proper rate; the "Sarco" feed water meter and feed water analyser are equally valuable adjuncts on occasion.

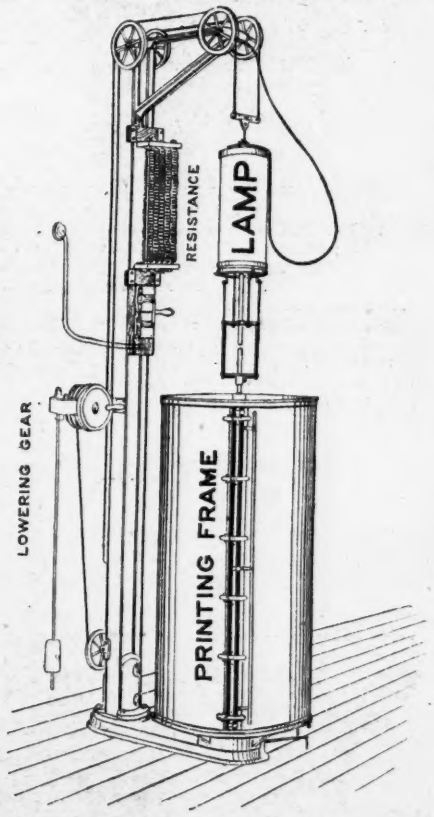
Want of space prevents us from detailing other specialities of a similar character, which are applicable by mining, steel-works and gas engineers; but all who require a little instruction, free in this case, in regard to boiler house economies cannot do better than call at this stand.

B. J. Hall & Co.

Messrs. Hall's stand is radiant with their patent electric copier, for taking photo-prints of engineers' drawings. Apparatus of this kind is a necessity in any large drawing office, and that this has been appreciated can be gathered from the fact that Messrs. Hall alone, have disposed of over 700 sets of the apparatus during the past six years.

Our illustration is of a Simplex pillar machine, as supplied by the firm. It consists essentially of a polished vertical glass cylinder, in halves, around which the tracings and photo paper are tightly secured by linen covers.

The cylinder is supported on a cast-iron base, on which also is fixed a pillar for supporting a photo printing arc lamp. The arc



Pillar Type of Electric Photo-Printing Apparatus.

lamp is adjusted in position by an automatic lamp-lowering gear, and is provided with the necessary accessories. The machine is self-contained and easily manipulated; readers who are interested can view the machine in operation, on the firm's stand.

A new rapid process of copying, styled Ordoverax, is also of considerable interest. An exposed, but undeveloped, blue print is placed face downwards on a sheet of metal or glass containing a thin layer of special composition; the latter having been previously poured on at a temperature of about 130° F. and allowed to set. After a slight application of pressure, the print is removed and an inked roller applied over the Ordoverax composition, the lines on which become inked.

Tracing cloth or paper, or ordinary paper, can then be applied to the impression, much in the same way as the original print, and a clear black lined scale reproduction results.

A large number of prints can be obtained from one impression, and any line not required can be deleted on the composition.

Willans & Robinson, Ltd.

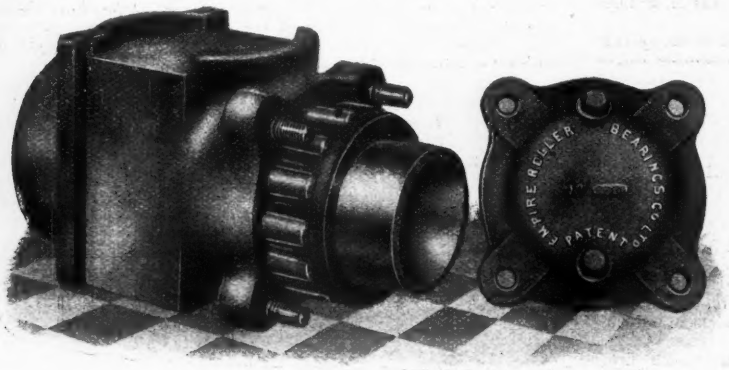
Messrs. Willans's stand will interest the engineer, if only by reason that the bearings, &c., on view, cast by the "Eatonia" process, are used by the firm in all their engine and turbine work. The success of this process lies in the fact that it ensures a practically complete equality in the structure of the alloy used for the bearing; the density is increased about 10 per cent., and the tensile strength from 50 per cent. to 100 per cent. As previously stated, the firm employ the process, but licences are granted and have

been taken up by many other firms to work it. The firm are also specialising in intricate iron castings, such as motor-car cylinders, and all kinds of aluminium work.

Empire Roller Bearings Co., Ltd.

Despite the reluctance which many engineers feel in superseding the old type of solid bearing, we think it must be conceded that the day of the roller and similar bearings has come, and that wherever efficiency is a *sine quâ non*, the older type of bearing with its somewhat deceptive (by comparison) low first cost, must go to the wall.

The Empire Co.'s stand is designed to show the various practical applications of their bearing; these include railway and tramway axle boxes, swivel and rigid shafting bearings, &c. The railway



Roller Bearing with Cap Removed.

and tramway types of bearing have been tested in service with very satisfactory results; as regards the latter, Mr. Goodyear's tests on the Croydon system, at that time leased to the British Electric Traction Co., Ltd., showed that there was an undoubted saving in energy of ·145 unit per mile run.

Fourteen bogie cars were fitted by the company, and the estimated annual saving per car per annum, with energy at 2d. per unit, amounted to £47 2s. 4d.; allowing for the extra cost of renewals, &c., a net saving of £33 16s. per annum was estimated.

As an instance of the value of the ordinary factory type of roller bearing, it may be noted that Messrs. Nobel were working 19 cartridge packing machines from their engine, but by substituting roller bearings for the ordinary variety, they increased the number of machines to 46, with an increase of 2 H.P. only, and a decrease in oil cost of nine-tenths.

Savage Bros., Ltd.

Messrs. Savage exhibit the 5-ton steam wagon, illustrated below. Its peculiarity lies in the 9½-KW. lighting set which is mounted on a steel combination bed-plate fixed to the framing of the wagon. The engine is a small enclosed high-speed unit, giving 20 B.H.P. at 500 R.P.M., and supplied with steam at 200 lb. pressure from the

Steam Wagon with Portable Lighting Set.

wagon boiler. The dynamo to which the engine is direct coupled is of the compound wound multipolar type, rated at 135 amperes and 70 volts. A sensitive governor and automatic lubrication are features of the plant, which, on account of its portability, is well adapted for supplying light on contracts which necessitate night work.

British Hele-Shaw Patent Clutch Co., Ltd.

Our readers will probably recollect the ingenious form of friction clutch devised by Prof. Hele-Shaw a few years ago; that this clutch is now a commercial reality will be gathered from the above company's exhibit. Of the various designs of clutch shown, all of which embody the series of corrugated disks peculiar to the inventor's design, the most interesting to electrical men is the ring type, which has found favour for the coupling of electric motors to various classes of machinery. The clutch consists of a core with inner plates, keyed to one shaft, and a case with outer plates, keyed to the other; the core and inner plates are entirely enclosed in the case, which forms an oil bath. The plates are compressed by pins which enter one end of the case, the pins being operated by a sliding sleeve of ordinary type. Triggers hold the pressure on the plates while the clutch is in gear; when out of gear, the pressure is relieved. This clutch is specially designed for slipping, and owing to its sensitive adjustment, it is possible to obtain a very gradual speed increment up to the maximum speed.

The clutch has been largely applied for motor-car work, and a reversing type has been designed for marine work where petrol motors are employed.

(To be continued.)

ELECTRIC HEATING FOR RESIDENCES.

At a recent Convention of the National Electric Light Association, Mr. James I. Ayer presented an interesting paper on residence electric heating, of which the *Electrical World* gives the following abstract:—

Mr. Ayer favours the introduction of electric heating devices by personal presentation, and recommends, for the use of solicitors, lists of meter readers' routes and a card catalogue divided into sections for a record. Circulars, or a typewritten letter with circulars, should be sent out a few days in advance, announcing a proposed call and its object. Articles should be left on trial after fully explaining their operation, and should be accompanied with complete printed instructions. The length of trial will depend upon the device; for flat-irons this should be about 30 days, and in some cases sufficient time should be allowed for the customer to note the effect on his bill from the central station. The customer should be called upon at the expiration of the trial period, instead of being communicated with by mail. It is a good practice to invite prospective customers to a practical demonstration of electric heating, such as cooking a light lunch to be served to them.

The electric iron is an ideal article for the introduction of electric heating. For laundry use they are required from three to five hours per week, costing from 15 to, at most, 50 cents per week; the latter being for the longest period at a 20-cent rate. It is fair to say that at the average rate the average family ironing can be done at from $1 to $1.25 c. per month. Using the flat-iron as an opening wedge, it is well to follow with circulars or folders describing such articles as water cups which will furnish a pint of boiling water in 7 or 8 minutes in the smaller size, or a quart in a larger size in 10 minutes. Either will supply enough for a cup of tea in 3 or 4 minutes, and for shaving in less time. These articles are invaluable in the sick room, and for use in hundreds of ways. Improvements in these devices prevent their burning out or overheating in the event of boiling dry. This result is obtained by the circuit being broken automatically if the temperature rises a few degrees above the boiling point.

An electric heating pad can always be placed in a home where there is use for a hot-water bottle. Its superior merit is immediately appreciated on the briefest investigation. Aside from its usefulness in illness, it is much used by the aged as a foot-warmer. A naval officer said he had many nights walked the bridge with a pad under his coat, comfortable in bitter weather, in spite of side remarks about "a monkey on a string."

The nursery milk warmer performs its work by electricity more

uniformly and perfectly than is possible with any other method, and in a shorter time. An important feature is that the time required to heat it throughout to an even temperature is less than three minutes, making the period so short after the demand is made that peace is certain. Its operation and sanitary character produce universal commendation from physicians. These devices are furnished with a socket plug arranged to receive the lamp which it displaces in the fixture, that is lighted when current is on the milk warmer.

Electric curling-iron heaters are welcomed in many houses. For light cooking and the dining room there are many useful articles. The chafing dish has many accomplishments to its credit. It can perform nearly all the operations of cooking required in homes, but, of course, in some cases not on the same scale as to quantity, and only one operation at a time, yet its possibilities are limitless when electrically heated. It can bake, boil, fry, stew and toast; it is under perfect control, and always performs the same under like conditions, because its heat supply is a known quantity. It is a simple matter to cook and serve a good American breakfast for three, of a cooked cereal, eggs poached, boiled, fried or scrambled, with toast, in 30 minutes with a chafing dish at a cost of 250 watt-hours, and coffee can be made for 100 watt-hours more—a total of from 3 to 4 cents at the average residence rates. The stove which operates the chafing dish makes, with a kettle, a most desirable combination for the tea table, and with a coffee percolator in place of the kettle, meets the requirements of the breakfast table.

Chafing dishes, tea kettles and coffee urns can be had with heaters attached or separate in a variety of grades and designs, and there is no other method so safe, simple or as cheap for performing similar service in the dining room. The cost for energy for performing any single operation with any of these devices is more often 1 cent or less than more, and never exceeds 3 or 4 cents.

For equally useful devices performing much the same work and more, in the dining room or kitchen, we must remember that the water cups previously mentioned come in as a part of the list, because they can be used for making coffee or tea, or boiling of any sort. In one case they are used for cooking French-fried potatoes. This type of heater is also made to form a combination of double boiler or cereal cooker, egg boiler, steamer, as well as a plain boiler.

Disk heaters, or stoves with utensils, such as saucepans, tea kettles, coffee pots, cereal cookers, vegetable boilers and the like enable the housewife with, say, two stoves and two or three utensils to do all the necessary cooking for light meals, in the dining room if she pleases, within the limits of cost previously mentioned. Stoves or disk heaters should always be supplied with utensils made for them of suitable proportions and with perfectly flat bottoms.

For general cooking there are available individual cooking devices in all sizes required for the largest household; also ovens, plate warmers, broilers, griddles, waffle irons, frying kettles, &c. Demands for general cooking will be to fill the place now occupied by gas stoves, which, except in apartment houses, are largely summer workers. Considering for the present those cases where the principal use is in summer, it is customary when using gas stoves to operate the coal range one or two days each week for supplying hot water for washing and the bath, and of course cooking at the same time, and this reduces in many cases the demand for service to perhaps six days each week.

Experience has shown from a great variety of sources that the number of watt-hours per meal per person may safely be taken at 300 or 900 per day per person. If, however, we allow 1 KW.-hour per person, we have 30 KW.-hours for a month, which at a 5 cent rate is $1.50, or for a family of four $6.00 per month; or at a 3-cent rate for the same family, $3.60 per month. While these figures are absurdly low to-day for lighting rates in residences, there are many cases where the service may be given from separate service wires at a satisfactory profit.

By careful comparison it has been determined that in cooking an equivalent cost for $1 gas is 2½ cents per KW.-hour, and while electric cooking is widely practical at a higher rate, it will demand from 5 to 3 cent rates to make it an important competitor to gas. Gas, however, occupies a broad field at a much higher price than coal, due to its advantages, and electric methods make it possible to secure equal results because of the many advantages possessed by the newer method over the old.

For heating the general water supply a kitchen boiler of the usual type is used varying in capacity from 10 to 30 gals., and supplied preferably with a heater contained in the boiler of a maximum of 2,000 watts, which may be reduced to 1,000 or 500 watts by a controlling switch. Such a boiler should be jacketed with ordinary pipe covering, and with care is not necessarily an excessively expensive luxury. A 10 gal. boiler can be heated to 150° F. with approximately 2½ KW.-hours, which will answer a very considerable demand throughout the day from a jacketed boiler of that capacity.

For bath water, heaters are supplied to place in the tub, and if of 2,000-watt capacity are frequently satisfactory to those who understand in advance that it requires 2,000 watts for an hour to raise 20 gals. of water through 40° F.

Radiators for occasional use in bedrooms for short periods are practical and useful, but should have a capacity of not less than 1,000 or 1,200 watts to be at all effective, except in the case of small rooms, and should be larger for large rooms. For heating the bathroom many radiators are sold which, to be effective quickly, should have 2,000 watts capacity. Of this size, if turned on for 15 or 20 minutes, they fully accomplish their purpose, and are not expensive to the owner.

The instantaneous hot water heater to be practical requires that current supply of 3,000 watts and more is available. While for small quantities the cost of operation is not excessive, the service demand is undesirable and it is expensive to install; and as small water-heaters are so much more simple and easy to supply, they meet the demand for small requirements. The field of water-heating radiators in any community, with rare exceptions, is very limited, yet the sale of these devices reaches a very considerable sum annually, and is daily increasing.

The service for a family kitchen for the average family for cooking should have a capacity of about 3,000 watts, and if a kitchen boiler, bath-water heater or bathroom radiator is to be included, a double-throw switch can be installed in the kitchen or other convenient place, so connected as to throw off the boiler, radiator, or bath circuit when the cooking circuit is required, and to avoid the necessity of extra large service capacity, which would otherwise be necessary. This also suggests a method of limiting the hours for cooking service to a period when lights are not required, but it has objections, although it is practical.

The cost for heating one gallon of water to different temperatures at different rates is given in the accompanying table, the initial temperature being 60° F., and the efficiency of apparatus 85 per cent.

Total temperature.	Watts used for— 5 m.	10 m.	20 m.	1 hour.	Cost in cents with current at 3 c.	5 c.	10 c.	20 c.
100° ...	1,296	648	324	108	.32	.544	1.088	2.17
150° ...	2,976	1,488	744	248	.74	1.24	2.48	4.96
175° ...	3,744	1,872	936	312	94	1.56	3.12	6.24
200° ...	4,608	2,304	1,152	384	1.15	1.92	3 84	7.68
212° ...	4,992	2,496	1,248	416	1.25	2 08	4.16	8.32

The policy to pursue is to personally press the sale of small household devices constantly, without complicating the situation by trying to interest customers with the larger problems, until from experience with the smaller they have become prepared for further ventures. During such a period one should gain practical experience in the larger problems in his own home. The small devices will earn from $1 to $2 per month, which will cover present transformer losses and leave a profit. When business depression comes one may cut off his electric signs, but not likely a house service, which provides many conveniences besides light.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

A Large Industrial Expansion.

The industrial situation in Germany at the present time is represented by the observation that practically all branches are strained to the utmost of their capacity to meet the demand, especially for the home market, and the position is accentuated by the comparative scarcity of supplies of raw materials, such as coal, pig iron, and semi-manufactured steel for working up into highly finished products. All the large firms in most departments of industry are endeavouring to extend and improve the methods of production, and the result is an accumulation of orders by machine builders, electrical engineering works and metal workers.

German Works.

The Continentale Gesellschaft fur Elektrische Unternehmungen (Continental Company for Electrical Enterprises), of Nuremberg, has not yet found an opportune moment for proceeding with a scheme of reconstruction. At the last meeting it was mentioned that if an alteration of this kind was to be made it should not be a gradual one. It was necessary not only to extinguish the deficit but also to provide funds to improve the working. The accounts submitted on that occasion show the following results:—

	1905-6.	1904-5.
Share capital	£1,600,000	£1,600,000
Loan ,, ...	469,000	469,000
Gross surplus	111,434	135,960
Net profits	467	260
Debit balance	92,589	93,056

The company will, perhaps, be remembered as the financial trust of the Schuckert Co., which still holds £1,441,000 of the total ordinary share capital. It is set forth in the report for 1905-6 that the proceeds from most of the enterprises closely associated with the company, again exhibited an improvement, although the final result was prejudiced by losses, of which no particulars are given. The report refers to the various undertakings which the company either controls and works, or in which it is financially interested. Among these may be mentioned the suspended electric railway between Barmen, Elberfeld and Vohwinkel, the Elberfeld tramways, and various other tramways and electricity works both in Germany and other countries. The total value of the investments is returned at £2,498,000, as compared with £2,635,000 in 1904-5, and the former includes £1,144,000 representing undertakings which the company manages on its own account.

Messrs Brown, Boveri & Co., of Mannheim, have taken an advancing step in the past three years in emulation of the increasing prosperity of their Swiss parent company of Baden. After meeting working expenses and providing for depreciation to the extent of 5 per cent. on buildings, 10 per cent. on labour-saving machinery, and 40 per

cent. on machine tools, the accounts show the under-noted results for the past two years:—

	1905-6.	1904-5.
Share capital	£300,000	£150,000
Net profits	22,878	9,480
Dividend, per cent. ...	6	5

The company distributed 4 per cent. in 1903-4, and the same rate in the two preceding years. In the course of the directors' report it is stated that notwithstanding day and night shifts, it was scarcely possible to keep pace with the orders both in the electrical and the turbine departments, and towards the end of the year the company was compelled to decline several large orders owing to the specified period for delivery being too short to allow of the acceptance of the contracts. The orders received during the year for steam turbines represented 110 of 180,000 horse-power, as compared with 63 of 89,600 horse-power in 1904-5, these figures relating to Germany alone. Special attention is drawn to the repeat orders, and although the largest turbine built by the company was of 9,000 H.P., it is expected that engines will soon be constructed up to 20,000 H.P. The electrical department was principally engaged on the production of machines for mines and ironworks and switchboard plant for high pressures, and this department also had to refuse orders during the year. The value of the total business on hand at the beginning of the present year was £375,000.

The Sachsenwerk, Licht und Kraft Gesellschaft (Saxon Works, Light and Power Co.), of Niedersedlitz-Dresden, is the company which emerged from the ruin of the ill-fated Kummer Co., and which has not yet made any progress. According to the report for 1905 the volume of business in dynamos and motors largely increased, but the final result was a loss of £9,400, which has increased the debit balance to £21,440 on a share capital of £137,000. The report attributes the unfavourable results partly to the fact that the sales did not reach the level arranged for by the organisation originally provided, and partly to initial difficulties of a constructional and manufacturing nature, although the latter are now said to have been overcome.

Swiss Companies.

The shareholders in Brown, Boveri & Co., of Baden (Switzerland), recently approved the accounts for 1905-6, showing the continued prosperity of the undertaking. Both the gross and net profits were higher than in the previous year, while the increased expenditure has not prevented a fresh advance in the dividend. The financial position may be summarised as follows:—

	1905-6.	1904-5.
Share capital	£640,000	£640,000
Bonds	200,000	200,000
Net profits	81,929	61,083
Dividend, per cent. ...	11	10

The handsome distribution made in the past two years compares with 9 per cent. paid in 1903-4, and 7 per cent. and 5 per cent. respectively in the two preceding years. The directors' report states that the works were fully employed throughout the year, steam turbines and electrical generators occupying the principal position. Since 1901 the steam turbines sold numbered 486, of a total of 769,347 horse-power, and of these 162 of 372,000 horse-power were disposed of in the past year. In the other electrical departments the orders received were plentiful, and engaged the plant to the limit of its capacity. Although the company has an abundance of orders on hand for the present year, the report characterises the industrial conditions as being by no means favourable, owing to the operation of higher duties under the new commercial treaties, and to the dissatisfaction existing among the workmen, notwithstanding the concessions already voluntarily made in the direction of the abolition of work on Saturday afternoons and a simultaneous increase in wages. With reference to the Simplon tunnel, the directors observe that the company undertook the electrical equipment at its own risk, and that the working has continued without interruption from the beginning. The report also deals with the financial situation of subsidiary companies in Germany, Italy, France and other countries.

The Bank fur Elektrische Unternehmungen (Bank for Electrical Enterprises), of Zurich, is an investment company on a large scale, judging from the considerable share and loan capital which has been issued, and the number of undertakings in which it is interested. During 1905-6 the bank refrained from embarking on fresh business, and the financial position works out as follows:—

	1905-6.	1904-5.
Share capital	£1,440,000	£1,440,000
Loan „	1,432,000	1,320,000
Net profits	149,709	129,851
Dividend, per cent. ...	9	8½

The profits arise from dividends on shares held in various companies and from shares disposed of during the year. Large realisations of shareholdings took place as the total investments were entered at £350,000 less than at the end of 1904-5, but participation in syndicate transactions increased by nearly £80,000. Among the sales were those referring to shares in the German Transmarine Electricity Co, the Barcelona Electricity Co., and the Italian Union Tramways Co., of Genoa. The profits realised on these sales have only been slightly drawn upon for distribution, inasmuch as the remainder has been devoted to the purpose of further writing down the book value of other shares, and the result of these transactions was to increase the liquid funds by raising the bank credit from £180,000 to £640,000 at the end of the financial year. Since then the bank has taken an interest in two new undertakings, one being in Westphalia and the other in Italy, which are expected to yield satisfactory financial results in the course of time.

MOTOR-STARTING RHEOSTATS FOR USE WITH THREE-PHASE INDUCTION MOTORS.

By AURILLAC.

Every engineer who is ever called upon to purchase, make or sell motor-starting rheostats for three-phase induction motors, will have discovered to his chagrin that there is an exceedingly great divergence of opinion among motor manufacturers as to the design of the rotors of such machines. Each designer appears to follow his own ideas on this subject, if, indeed, he has any ideas. If he has no ideas of his own on the subject, he must perforce make slots which may or may not lead up to an efficient machine.

Viewing the subject broadly from the point of view of the contractor who wishes to keep the total cost of the motor equipment as low as possible, the rotor conductors should be of such proportions that the amount of copper employed in the starting gear and accessories may be kept as low as possible. It is a general rule that, provided resistance units can be employed economically for any current-carrying capacity, the cost of a rheostat capable of dissipating a definite amount of energy will increase as the carrying capacity increases, owing to increased dimensions of the switch parts and of the copper connections between the switch and the motor. This rule, however, cannot be taken as correct in every case, because some makers do not employ resistance units having a sufficient freedom of design (if we may be permitted to use such an expression) to enable them to contract resistances to dissipate a certain amount of energy at any conceivable current economically.

Generally speaking, it will be found that iron wire resistance units of some description or other will serve until we reach currents up to, say, 10 amperes. Between 10 and 20 amperes the manufacturer has at his disposal either small section cast-iron grids or resistance units, consisting of iron or steel ribbon wound on iron frames and insulated from them by micanite. Above 20 amperes and upwards, various designs of cast-iron grids will be found most economical. Of course, the currents mentioned above are the ratings for continuous service; it will be apparent that each class of unit will have a far wider range of ampere capacity if used for starting duty only. Liquid resistances are in fairly general use, although they are not in such general use as metallic resistances, and the reason seems to be that although their first cost is so much less, the labour part of the maintenance account is found to be rather heavy, and if they do not receive skilled attention, deterioration is very rapid.

It must not be assumed from the above that we entirely condemn liquid resistances, but experience has shown that they suffer from defects, if left in unskilled hands, which are far more disastrous than in the case of metallic resistances.

Now a word with regard to the switch parts of motor starting rheostats. We will limit ourselves for the present to the problem involved in the design of moderate sized rheostats up to 100 H.P. capacity, whose rotor currents do not exceed 250 amperes. For all these rheostats it will be found possible to use the well-known sliding contact type of switch having three sets of contacts at an angle of 120°.

For motors whose normal full load rotor currents per phase do not exceed 50 amperes, the ordinary button contact type of front may be used, having a light contact shoe held down by a spring, while for motors having rotor currents above this value some form of renewable contact should be used with a carbon contact brush, and having an auxiliary contact in the full on position to relieve the carbon brush. The only other point of importance involved in the design of the rheostats, apart from the general question of insulation which we consider has at last been satisfactorily settled by the various manufacturers, is that of the number of contacts required. In spite of all the efforts of consulting engineers and central station engineers with their voluminous specifications, there seems to be a general consensus of opinion that in continuous current work 8 contacts are sufficient up to about 10 H.P., while from 10 to 13 contacts will suit for any size up to 50 H.P. In the case of alternating-current work it is considered good practice to employ about 10 contacts per phase on all sizes up to 100 H.P., and for currents up to 250 amperes.

The reason for this will be apparent when we consider that the number of contacts any motor starting rheostat must have (from a theoretical standpoint) is a constant quantity for all sizes of three-phase motors having the same efficiency and the same proportional distribution of losses.

This fact, together with the fact that although there is so little standardisation of three-phase induction motors, the contractor demands as quick delivery of three-phase motor starting gear as he has come to expect in the case of continuous-current work, will obviously render it a good business policy for a manufacturer to stock two or three standard sizes of switch fronts for three-phase rheostats, each of which will be suitable for any rotor current up to the maximum for which it is designed.

So that, while hoping for better days, he will take his standard front off the shelf and build the resistance which he has been able

to design in a few minutes by the use of suitably drawn curves, and by dint of hard work enable the contractor to get his motor running to time.

We have mentioned the use of certain curves above. Needless to say, every engineer engaged on work of this description keeps by him a series of curves plotted for all sizes of three-phase induction motors. One series of curves will connect brake horse-power and starting resistance per phase, each curve being plotted from calculations on the assumption of a reasonable efficiency, and slip for a definite voltage across slippings at starting. The other series will connect rotor current per phase and brake horse-power, each curve being plotted on the same assumption as before. These two series of curves once plotted will be found an invaluable aid to all who are called upon to make such calculations rapidly.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Electric Heating and Cooking.

The British Prometheus Co., Ltd., of Salop Street Works, Highgate, Birmingham, are displaying considerable activity at present in pushing their system of electric heating and cooking. In addition to the new works at Birmingham, they have opened a fine large showroom at 109, Oxford Street, London, W., where

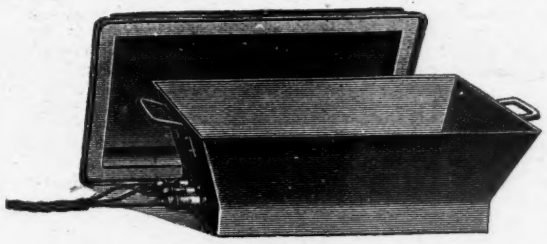


Fig. 1.

they are able to exhibit their apparatus to far greater advantage than was possible in the old premises at Ely Place, and we believe that the trade have only to have their attention directed to the existence of this conveniently situated exhibition for them to take advantage of it. We need hardly mention that it is intended purely for the purposes of the trade (all articles being marked with catalogue prices), who can take their clients there to make their own selections from among the great variety of electric kettles, hot-plates, flat-irons, and so forth, that are arranged conveniently for easy inspection. The many exceedingly artistic designs of convectors

Fig. 2.

Fig. 3.

and radiators, and the combination of both, afford evidence of the advance that has been made in producing these apparatus in such designs that they will effectively meet the tastes of the most artistically inclined and harmonise well with luxurious furnishings. One of the best things shown at Oxford Street is an example of a number of elaborate convectors that were supplied through a Scottish contractor for an Atlantic liner. A new general heating catalogue has lately been issued by the company, and one containing quite a number of new designs of radiators and convectors will appear in the course of a week or two. From the one now before us we select a few interesting lines for illustration. A full general description of the "Prometheus" system and some views of the works are followed, in this catalogue, by a large number of illustrations and tables of prices of stew-pans, saucepans, hot-plates, cooking ranges, ovens, water-heaters, kettles, curling tongs, sterilisers, urns, flat-irons, and, indeed, almost everything one can think of that electricity has yet been adapted to in the way of heating. Fig. 1 represents a cast-iron braising pan; fig. 2 a copper water jug; fig. 3 shows a rapid water-heater with nickel-faced steel outer case. The water passes between two thin concentric tubes, and on the outer tube a number of ring elements are assembled; it then flows out through the outlet pipe, the rate of flow being controlled by the valve on the inflow. Particulars of the construction of electrically heated irons, and working instructions for the same are given. Fig. 4 shows a somewhat heavy pattern for tailors' or dressmakers' use. Fig. 5 represents the

Fig. 4.

Fig. 5.

company's most popular form of flat iron, which has been specially designed for use in laundries, chemical cleaning and dye works, and many hundreds are in use in some of the largest dry-cleaning works in the country. It has a nickel plated flexible metallic tube and tube carrier, and requires about five or six minutes to attain its normal working temperature. For "dry" ironing, the normal watts are sufficient, but for semi-wet work, such as lace curtains, the irons are constructed to take 500 to 520 watts.

New Conduit Fittings.

The Metallic Seamless Tube Co., Ltd., of Birmingham, are bringing out some new fittings in connection with conduit wiring, which we illustrate herewith. Fig. 1 is a watertight box which

Fig. 1.

has been introduced to meet the current great demand for watertight installations. A watertight lining is inserted between the

Fig. 2.

cover and the edges of the box. The boxes are made of the uniform size, and with any size outlets up to 1 in. They can also be supplied with 2, 3, or 4 ways. The box has a good capacity, and affords ready access to the wires. It is considered that the price

being low, the box should take the place of tees, elbows and bends. In fig. 2 is shown a special inspection elbow, having the inspection lid on the side instead of in the front, as is usual. We understand that this particular type of fitting has been found very useful in one or two special instances.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Johannesburg Council Wiring Rules.

I note in your issue, dated August 10th, that you have reviewed the copy of the above which I sent you recently, and I have to thank you for your remarks. There are, however, one or two points in your article to which I would like to draw attention :—

1. The rules were adopted by the Council on May 9th, 1906 : the 1905 was a printers' error.

2. With regard to paragraph (*g*), under the heading of "Motors," I note that the limit of rise in temperature [of starting resistance coils], viz., 212° F. is stated by you to be hardly fair. You have evidently overlooked the increased risks under which the supply is given due to the excessive dryness of the atmosphere, and consequently the greater risk to inflammable materials in the vicinity of such coils than obtains in England.

3. I note that you state that the Fire Office rules do not conform in many important respects with the I.E.E. rules. In stating this you evidently have in mind the Fire Insurance rules in England. Those adopted by the Transvaal Fire Insurance Association are practically identical with the I.E.E. rules, only they set out in greater detail their requirements. In the first paragraph of the Transvaal Fire Insurance rules the following appears :—

"These rules are based on the general rules published by the Institution of Electrical Engineers and recommended for wiring for the supply of electrical energy, as revised in 1903."

J. F. I. Thomas,
General Manager.

Gas, Electric Supply and Tramways Dept.,
Johannesburg, *September 3rd*, 1906.

[The dry and rarefied state of the air was mentioned in the last sentence of our article ; but we did not perceive that this had any bearing upon the temperature limit of starting resistance coils. Such coils should always be surrounded by an incombustible ventilated case, and according to the I.E.E. rules, not only is the maximum temperature rise of the coils limited to 240° F., and that of the cases to 130° F., above the surrounding air, but no unprotected inflammable material is to be within 6 in. of the cases, or 24 in. above them. Still, the point is of minor importance, and certainly if the regulations err, it is on the side of safety.—Eds. E.R.]

Manufacturers Selling Direct to Consumers.

Being what certain of your correspondents would term a "guilty party," I would like to give you an illustration of the way in which certain "contractors" deal with the question.

In a certain town an eminent "trade" firm would not touch our goods on the ground that there was no demand for the articles, and so, to create a demand, I sold a quantity of goods direct to a number of consumers *at list prices*, thus proving the existence of an effective demand.

The "trade" firm, with true business instinct, seeing money in it, canvassed my customers, and offered substantial discounts ; such discounts, in fact, that nobody except very large firms could possibly compete, and such as I am absolutely prohibited, by the terms of my agreement, from offering to anybody not in the trade.

Numberless instances of this sort of thing can be produced, and, on the whole, the less said by "contractors" about "direct dealing" the better.

The very existence of the alleged evil shows their lack of enterprise.

Candid Friend.

Birkenhead, *September 22nd*, 1906.

Charging Accumulators.

With reference to the above in this week's Review, in addition to the causes so clearly explained by the editors, there is another cause which greatly augments the tendency for some ammeters to swing under these conditions, *i.e.*, when the natural time of vibration of the ammeter needle happens to be in sympathy with the impulse of the engine.

Suppose the ammeter needle is making 100 vibrations per second when swinging clear of the stop and without any current on, and the impulses of the engine are 100, or even 200 per second, this is a favourable case for sympathetic vibrations to be set up.

When this is the only cause the swinging will entirely disappear if the engine is speeded up, and resistance put in the field circuit to give the same current as before.

E. T. Cottingham.

Thrapston, *September 22nd*, 1906.

[Our correspondent is quite right, apart from his obvious slip of the pen in writing "second" for "minute." We had included this factor in our note, but struck it out on the ground that while the other factors were almost certainly present, the probability of resonance was remote, and the change of speed was as likely to bring resonance into existence as to destroy it. We should add that impulses of twice the frequency of the needle will not produce resonance.—Eds. E.R.]

Electric Pumping at Collieries.

With reference to Mr. Hooghwinkel's letter in your last issue, on referring to page 4 of the pamphlet in question, we read the following :—

> The first large installation erected on this principle was the pumping plant for the Hocayo mines, Spain. Small centrifugal pumps driven by electric motors were installed on each pumping level as the workings increased in depth. The pumps needed no supervision, and the loss of energy usually incurred by letting the water flow and accumulate in the sump at the pit bottom was avoided. Another advantage was that the capacity of the installation could be gradually increased, with very little cost. *With plunger pumps, either steam or electrically-driven, a division of the pumping plant in this manner would be impossible, owing to the high cost, and still higher working costs.* The water pumped from its proper inflow level is also much clearer, and has therefore a certain value when brought to the surface.

The italics are the writer's, and to anyone with a knowledge of mine pumping, such a statement is absurd, to say the least. Special feeders of water are often pumped from mines, either for boiler use or domestic supply, in which case they are usually fed into a tank from which the water is pumped—but not necessarily by a centrifugal pump. In the case of Hocayo (or Horcajo) mine, however, the water is all pumped from the bottom of the shaft, and the same water passes through each pump in series, which is equivalent to pumping all the water from one large pump at the pit bottom. Further comment is needless.

T. C. F.

Cost of Suction Gas Power.

In view of the dismal description of "The other side of the shield," given by the writer of the contribution under the above heading, the following particulars may be interesting.

A part of the plant under my care consists of three gas-driven generating sets of 50 kw. each ; gas being supplied by one suction gas plant. The plant, which is that of large engineering works, has now been running over two years, and, I think, I may safely say that we are well past the test-bed stage. The engines are direct coupled to the generators, are governed by the usual hit or miss gear, with an additional throttle-governor on the gas inlet, and were supplied by an entirely different firm from the one which supplied the gas plant. Now, with a highly fluctuating load, such as cranes, planing machines, foundry blower, and electric shunting locomotive, we have not yet experienced any of the troubles so vividly pictured by your contributor.

That an unskilled man can run a suction gas plant I have proved beyond doubt; as one of the men now running a shift was a handy labourer when I took him on, and the other, although he had been running a steam engine, had never run a gas engine, or seen a gas plant. Both men mastered the job in about a week, and neither of them has yet been poisoned or blown up.

With regard to fuel, there is no need to use good and costly coal, for the results from coke are quite satisfactory, and the fire much cleaner than when anthracite is used.

The only stock of spares we carry consists of: One set of fire-bars, one set of fire-bricks for lining, one nest of vaporiser tubes, and a few cramps for purifier lid and mud doors. Of these in two years we have used one set of bars, and two dozen bricks; our only other repair was a new gauge glass.

Referring to the statement of Mr. Tookey, that "for more than 12 hours' continuous work two generators should be provided," I may say that the plant often runs from 5.30 a.m. until 11 p.m., and has often run from Monday morning until Saturday noon without once having load off; all clinkering is done from fire doors during meal times. The fire is banked week ends, and is only put out at two months' intervals.

The supply of water to vaporiser is controlled by ball valve, and the steam supply always equals the demand.

The ignition on the engines has two positions—"late" for starting, and running position. The starting occasions no trouble, the gas being so uniform in quality that the engine will always start with gas and air regulators in one position, and rarely fails to fire on first cycle.

The following are details of a month's running, which show that although some makers' statements of "one penny for 20 B.H.P.-hours" may be putting costs much too low, they do not err any more in one direction than does the writer of the article in the other :—

Coke consumed, 22 tons 5 cwt. at 12s. 6d.	£13	18	2
Water, 88,800 gals. at 6d. per 1,000	2	4	5
Wages	16	15	4
Oil	1	13	6
Sundries	0	15	0
Scrubber and purifier renewals	0	5	6
Interest and depreciation	22	10	0
	£58	1	11

Total output	14,257 B.T.U.
Cost per unit	·97d.
Coke per horse-power-hour	2·22 lb.
Average load	44·7 KW.
Total running hours	319
20 B.H.P. for one hour costs	2·9d.

R. Weaving.

Peterborough, *September 24th*, 1906.

The writer of the communication in your issue of the 21st inst., under the above heading, has referred to me as "one of the champions of suction gas plants," and I should be glad if you would permit me to say that, although I resent his imputation of undue partiality to this type of cheap gas-making apparatus, the perusal of the article has given me much amusement. The way "a fair summary of the case" has been concocted is distinctly humorous.

Jerome, in "Three Men in a Boat," describes how a peep into a medical book convinced a reader that he had, at one and the same time, the symptoms of typhoid fever, St. Vitus's dance, Bright's disease, cholera, &c. It appears that the author of your "communication" is a person similarly afflicted with mental inertia.

The statement made in the first paragraph of the article that "bold assertions are only partially true," is proved under each heading. Generalisations of an indefinite nature are always safe from refutation. If one were so minded, similarly sweeping comments could be made with regard to electric motors, with as little foundation on fact.

The "unskilled operator" seems as troublesome to your correspondent as was "King Charles's head" to a certain individual in fiction. It is evident that the writer's opinion is that an unskilled operator always remains an unskilled operator. My experience has been that an operator previously unskilled in gas making becomes proficient in a very short time. The whole plaint suggests the stifled atmosphere of books rather than the open air of practice.

(I like the word "obsolescent." It sounds novel, and will be most appropriate for use in connection with certain types of motors, switches and electrical fittings.)

But, after all, why this tirade against suction gas producers? The advantages of internal combustion engines have been fully recognised by electrical engineers for many years past. In numberless country residences the gas or oil engine has made electric lighting a possibility, where other power generators have been tabooed. For an electrician to go out of his way to find fault with the fuel that most economically serves the prime mover of an electrical installation, would seem to offer an opportunity for an additional moral fable *à la* Æsop.

W. A. Tookey.

London, S.W., *September 24th*, 1906.

[Mr. Tookey replies in generalisations which, if properly applied, might drive an engine. The actual data given in Mr. Weaving's letter suggest "the open air of practice" rather than the "stifled atmosphere" of Mr. Tookey's remarks.—Eds. E.R.]

THE SOURCES OF ERROR IN THE HARCOURT 10-C.P. PENTANE STANDARD.

By J. S. DOW, B.Sc.

As the Harcourt 10-C.P. Pentane lamp seems likely to remain our standard of light for the present, an account of some experiments made by the author at the Central Technical College on some of the possible sources of error connected with it may be of value.

For these experiments, three large-bulb 100-volt 50-C.P. glow lamps were selected and "aged" by being run off 100 volts for 50 hours. Two of these were used as reference standards, the third being put aside to serve as the primary standard, in terms of which all candle-powers were measured. All three lamps were run off a constant P.D. of 95 volts when in use; for, at this pressure, the colour of the light from the glow lamp was exactly the same as that of the pentane standard. The difficulty of judging the photometer was thus reduced to a minimum, while all possibility of colour effects was avoided. Under these circumstances it was considered possible to repeat the mean of a set of photometrical results to well within 0·5 per cent.

The P.D. across the lamps was measured on an electrostatic voltmeter having a very open scale in the neighbourhood of 90-100 volts, so that the P.D. could be read, with care, to $\frac{1}{2}\frac{1}{0}$ per cent. The voltmeter was calibrated by means of a couple of Clark cells and a potentiometer from time to time, and the calibrations of the part of the scale used agreed to within $\frac{1}{1}\frac{1}{0}$ per cent.

Fortunately, it was always possible to obtain the necessary P.D. from a battery of accumulators which were being used for no other purpose, so that the regulation of the pressure across the lamps presented no difficulty.

Before investigating the effects of atmospheric moisture and barometric pressure, a series of experiments were made to determine what errors could be introduced in adjusting the lamp for ordinary use.

The regulation of the height of the flame, always a source of uncertainty in the case of flame standards, appears to be not without effect in this case.

Fig. 1 (p. 492) gives the mean of six sets of determinations made on different days. The maximum candle-power is obtained with the tip of the flame in its correct position, and it will be seen that, with reasonable care, the error should lie within 0·5 per cent. It is to be noted, however, that the raggedness of the flame-tip would probably cause appreciable differences in adjusting the height of the flame on the part of different people. Again, if the flame-tip were viewed through coloured glass, the results would be distinctly different to those obtained when it is viewed with the naked eye.

The height of the flame may be adjusted in two ways. The cock communicating from the reservoir to the burner may be adjusted, while the air supply cock is kept full on; or, conversely, the adjustment may be made at the latter while the former is kept in a given position. The first

method has always been employed by the writer, but both methods are in use. It therefore seemed possible that a difference in the proportions of the mixture of air and pentane in the reservoir, in the two cases, might result in a difference in candle-power, but a series of tests on this point failed to reveal any distinct difference.

Some experiments were also made on the effect of using different sized gauge blocks. As might have been expected, it was found that, for small variations, the candle-power is roughly proportional to the length of flame uncovered. The

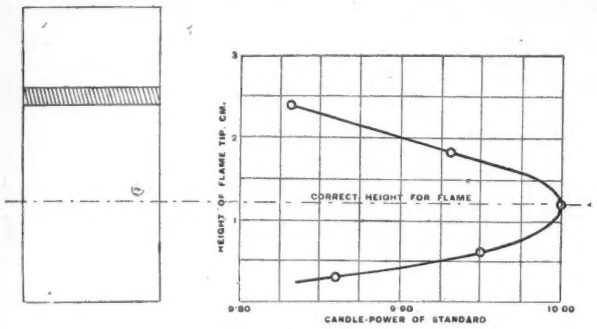


Fig. 1.

correct gauge block is about 46 millimetres in length. An error of half a millimetre in setting the lamp to the block, would therefore be necessary in order to make a change of 1 per cent. in the light, and a number of tests showed that the lamp could be reset to the block over and over again, without affecting the light appreciably.

The statement that the level of the pentane in the reservoir is immaterial in affecting the light, as long as it can be seen through the glass, also appears to be correct.

A question of some importance is the length of time which must be allowed to elapse for the lamp to assume a steady state. For some five to ten minutes after the lamp has been lighted, the flame has to be continually turned up. This is succeeded by a period during which the flame has to be turned down, and at least half an hour must elapse before the flame remains steady for any length of time.

It was found, however, that sufficiently consistent readings could usually be obtained after the lamp had been burning about 15 minutes.

The five curves in fig. 2 are typical of the results usually obtained. Except in the case of No. III—to which reference will be made shortly—the results fall within the limits of observation after about 10-15 minutes.

The ventilation of the photometer room is very important. The room in which these curves were obtained was a large one—about 30 ft. × 36 ft. —and was always thoroughly ventilated before beginning to take readings. Nevertheless, it was found that the candle-power of the Pentane lamp nearly always gradually fell if any other observers were working in the room at the same time. In such cases a ventilation of the room resulted in the light returning to its former value.

In fig. 2 the dotted portions of the curves represent what happened while the door and window were thrown open. When Curves I, II, IV and V were obtained, no one else was working in the room, and at the end of 50 minutes the readings had not changed very appreciably. On opening the door and windows for 5-10 minutes only a very slight rise in candle-power followed. While curve No. III was being obtained, a student began work in the room about 25 minutes after the lamp had been lighted. After this point there were two gas burners besides the Pentane burning in the room, and the candle-power gradually dropped to nearly 3 per cent. below its original value. A ventilation of the room for 15 minutes restored the candle-power to its former value.

On one occasion when there were five other workers in the room, and four gas jets burning, the candle-power fell as much as 7 per cent. Dr. Fleming mentions a case* in which vitiation of the atmosphere resulted in the candle-power of the Pentane lamp being reduced by 8-10 per cent., and it seems probable that the errors introduced in this way would materially interfere with the accurate application of Mr. Paterson's formula† correcting for water vapour and barometric pressure, in the comparatively small rooms usually devoted to photometry.

These changes cannot be explained by the comparatively small changes usually observed in the water vapour present. Formulæ have been suggested allowing for the amount of carbon dioxide present in the air, but the true explanation lies rather in the deficiency of oxygen supplied to the burner than the actual presence of carbon dioxide.

The position of the "centre of illumination" from which we must measure in order to get consistent results by the inverse square law depends for any screened flame standard upon—

1. The centre of illumination of the flame itself.
2. The fact that the length of flame visible through the slit, and therefore the candle-power, will be greater at a small distance from the photometer. The position of the centre of illumination for the Pentane 10-c.p. power lamp does not appear to have been studied, but Liebenthal ‡ found that for the Harcourt 1-c.p. Pentane standard the centre of illumination should be taken midway between the axis of the flame and its outer edge. Even this relation did not hold for very short distances from the photometer.

In order to study this point, the Pentane lamp was compared against a large-bulb incandescent glow lamp run at a p.d. of 95 volts, the distance between the two being varied from 100 to 300 centimetres.

In any experiment of this nature, differences in the results at different distances might be put down to wrong location of the centre of illumination of either the Pentane standard or the glow lamp. It is essential, therefore, to take all possible precautions against the latter being wrongly determined. The glow lamp had a horse-shoe filament, the filament lying accurately in one plane and arranged with this plane perpendicular to the bench. The centre of illumination may then be assumed to lie in this plane, and experimentally this has been found to be true. Lamps having filaments of this type may be compared against one another at distances varying from 100 to 300 centimetres

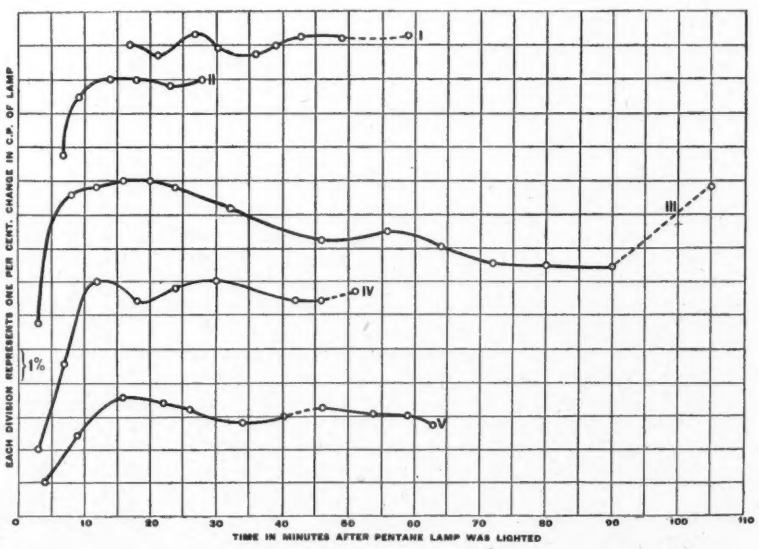


Fig. 2.

* *Proc.* Inst. of E.E., 1903, Vol. XXXII, p. 136.

† Electrical Review, Aug. 26th, 1904, p. 355.

‡ *Electrotech. Zeitschrift*, 1895, p. 657.

with very consistent results. The lamp was arranged so that the plane of the filament was exactly over the index-marks on the carriage on which the lamp was mounted, but any possible error in this respect was avoided by reversing the carriage and taking the mean of the results in each case. Moreover, the candle-power of the glow lamp was roughly four times that of the standard, and consequently the distance of the photometer from the glow lamp about twice that from the standard. Hence any error in the location of the centre of illumination of the former produces a correspondingly small effect.

Special attention was given to the ventilation of the room, but any gradual change in the candle-power of the Pentane lamp was eliminated by repeating the set of readings in the reverse order and taking the mean.

The experiment was repeated on three separate days, and the Table below gives the mean of these three sets of observations.

Approximate distance from Pentane burner to photometer screen. Centimetres.	Candle-power of Pentane taking centre of illumination as central axis of flame.	Candle-power of Pentane taking centre of illumination as half way between central axis and outside of flame.
104	10·10	10·00
91	10·11	10·00
77	10·13	10·00
63	10·17	10·01
49	10·28	10·09
42	10·37	10·12
35	10·55	10·16

The figures in the third column agree extremely well, and show that much better results are obtained by adopting Liebenthal's conclusion. In any case it ought to be generally understood which of these points is to be adopted, for the distance between them is about 5 millimetres. Hence a difference of at least 1 per cent. would be introduced between the results of observers who follow Liebenthal's rule and those who do not. If the more convenient but less correct plan of measuring from the central axis of the burner is followed, it is desirable that all standard measurements should be made with the photometer set roughly at a specified distance—say, 1 metre—from the standard.

The writer has repeated Mr. Paterson's investigation into the effects of water vapour and barometric pressure. The two secondary standard glow lamps already referred to were compared against the Pentane and then compared against the primary standard in each case. Taking two separate observations in this way enables one to detect abnormal results and reduces any errors in reading the photometer and adjusting the sources of light to a minimum, while the method of double comparison admits of the standard glow lamp being run for a very short time only each day.

The water vapour present in the air was measured by the mean of the readings of two wet and dry bulb hygrometers. It has been stated that the ordinary wet and dry bulb hygrometer is not sufficiently accurate for this purpose. In this case, however, the results from the two hygrometers rarely differed by more than 2 per cent., and this could only mean an error in the candle-power of under $\frac{1}{10}$th per cent.

The barometric readings were made on a very sensitive aneroid instrument, which was frequently compared against a standard mercury barometer. The barometric pressures observed varied from 748 to 771 millimetres and the water vapour from 7 to 20 litres per cb. metre of air. The candle-power of the Pentane standard varied over about 10 per cent. Upwards of 50 observations were made during the months of April, May, June and July. About half a dozen of these results showed the Pentane to be abnormally high, all being more than 2 per cent. to 5 per cent. higher than one would have expected from the remaining readings. The reason for these high results was never discovered, but as they clearly did not represent the normal behaviour of the lamp, it was eventually decided to put them aside.

There remained 50 different observations from which the formula was calculated by the method of least squares. Calling a the water-vapour present, in litres per cubic metre of pure air; b the barometric pressure in millimetres; and assuming the lamp to give 10 C.P. when the water vapour in the air is 10 litres per cb. metre of air, and the barometric pressure 760 millimetres, the relation worked out to :—

$$\text{Candle-power} = 10 + 0{\cdot}071\,(10-a) - 0{\cdot}0085\,(760-b);$$

all things considered, this agrees very closely with Mr. Paterson's formula, viz. :—

$$\text{Candle-power} = 10 + 0{\cdot}066\,(10-a) - 0{\cdot}008\,(760-b).$$

Of the 50 observations taken, 28, or 56 per cent., fell between 0·5 per cent. of the calculated values; 39, or 78 per cent., fell between 1 per cent., while none of the remaining observations fell without 2 per cent.

The mean deviation from the calculated value was only 0·7 per cent.

It is interesting to compare these relations with those obtained by Liebenthal* for the 1-C.P. Harcourt standard and the Hefner lamp.

Liebenthal's formulæ for the changes in candle-power due to water-vapour in the atmosphere, in the two cases, are :—

$$\text{For the Hefner Amyl acetate lamp, C.P.} = 1{\cdot}049\,(1 - 0{\cdot}0053\,a).$$

$$\text{For the 1-C.P. Pentane lamp, C.P.} = 1{\cdot}232\,(1 - 0{\cdot}0055\,a).$$

It will, therefore, be seen that the change produced by water-vapour is of the same order for the 10-C.P. standard as for the 1-C.P. Pentane and Hefner lamps, but that it is larger in the case of the 10-C.P. Harcourt standard.

The corresponding formulæ for corrections due to changes in barometric pressure, for the two lamps mentioned above, were found to be :—

$$\text{For the Hefner Amyl acetate lamp, change in C.P.} = 0{\cdot}00011\,(b - 760).$$

$$\text{For the 1-C.P. Pentane lamp, change in C.P.} = 0{\cdot}00049\,(b - 760).$$

It appears, therefore, that the change in candle-power of the 10-C.P. standard for a given change in barometric pressure is nearly twice as great as for the old 1-C.P. Pentane standard, and about eight times as great as for the Hefner lamp.

It is interesting to note, in passing, how insignificant the effect of barometric pressure on the Hefner lamp appears to be, for a change of 40 millimetres in barometric pressure would affect the light by less than 0·5 per cent.

On the other hand, Frankland,† as far back as 1861, found that the light from coal gas flames was decreased 5 per cent. for each diminution of 1 in. in barometric pressure—a far greater change than even the 10-C.P. standard is subject to.

No explanation seems to have been offered why different flames should be influenced so differently by barometric pressure. But if such differences as those recorded above, both for barometric pressure and water vapour, really exist between existing lamps, it does not seem inconceivable that a flame standard might eventually be designed which was practically independent of these two sources of uncertainty.

In any case, the 10-C.P. standard compares unfavourably with the older standards in this respect.

The Lighting of Mills and Workshops.—In its issue of September 18th, the *Journal of Gas Lighting* acknowledges the errors pointed out in our issue of the 7th inst., and publishes a reply to our comments by the author of the paper, who accepts full responsibility for the accidental "jumble of figures," by which the cost of gas lighting was divided by 50. Mr. Pollitt adheres to his figures for capital outlay, and says "it is ridiculous to talk of a complete installation at an average of £1 per 16-C.P. lamp." Nevertheless, mill lighting can be, and has been, done at this figure, as those of our readers who have had actual experience in this class of work will agree. We should like to know the date when the tender quoted by Mr. Pollitt was submitted; our gas friends are in the habit of comparing antiquated types of arc lamps with their latest gas lamps, and we should not be surprised to learn that his figures were prehistoric.

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* *Electrotech. Zeitschrift, ref. cit.*

† *Proc. Roy. Soc.*, Vol. XI, page 137.

BUSINESS NOTES.

Installation Contracts.—Messrs. Duncan Watson and Co., have secured the following contracts, to be completed within the next nine months:—

120-h.p. direct-coupled gas-driven sets and 120 arc lamps, with complete installation, for large premises in North London.

Two oil-engine plants, with accumulators and complete installations, with fittings, for Isle of Thanet.

One oil-engine set, with complete plant, for Burnham-on-Sea; also with fittings.

One gas-engine plant, with complete installation, for Herne Hall, Bushey.

Two organ-blowing equipments, also installations with fittings, for the Church of the Sacred Heart, Wimbledon; the Congregational Union, North London; the Congregational Union, South London; Foundling Hospital, new wing; arc lighting installation, including 54 arc lamps, for North End, Croydon, and a number of other smaller installations.

Consular Notes.—Canada.—The French Consul at Montreal, in a recent report, states that the imports of electric lighting apparatus into Canada increased to $1,903,791 in 1904-5, as compared with $1,842,026 in 1903-4; of this value, $1,834,426 came from the United States, $37,922 from Germany (in 1903-4 the value from Germany amounted to only $2,226), and $27,124 from the United Kingdom; the imports from France amounted to $2,592 value. Electric motors and dynamos were imported to a total value of $848,260, as compared with $504,571 in 1903-4. The greater proportion of these goods (to the value of $819,288) are from the United States. The imports from Germany have increased from zero in 1903-4 to $16,694 value in 1904-5; the imports from France amounted in value to $1,019.

Book Notices.—*American Street Railway Investments.* New York: McGraw Publishing Co. $5.—This is the 1906 issue of this red annual, published in connection with the *Street Railway Journal*. The 1906 edition contains 432 pages of statistical matter—an increase of 17 pages over the edition of 1905. It also contains 47 maps, on which the systems of 52 separate companies are shown. Financial statistics are included of all of the street railway companies of the United States, Canada, Cuba and the United States insular possessions. The statistics include, in most cases, operating reports and balance-sheets, besides a history of the corporate organisation of each company. The *résumé* of gross receipts for 437 companies, published in the first four pages of the book, indicates a marked increase in earnings of the street railway companies of the country.

"German Scientific and Technological Reader." Books I and II. By E. Classen and J. Lustgarten. London and New York: Harper and Bros. 2s. net each.

"A Manual of Hydraulics." By R. Busquest. Translated by A. H. Peake, M.A. London: Edward Arnold. 7s. 6d. net.

"The Dead Points of a Galvanometer Needle for Transient Currents." By Alexander Russell, M.A. Excerpt from the *Proceedings* of the Physical Society of London, Vol. XX.

Telephones in Turkey.—A recent Imperial decree provides for the importation of house telephones without restriction. Other telephonic installations are prohibited as before.

Wolfram Lamps.—It is reported from Vienna that the Osmium Light (Auer) Co. has disposed of the patents for the "Johann Lux" wolfram incandescent electric lamp to the American Westinghouse Co., which has formed a new firm under the title of the Westinghouse Metallfaden und Gluhlampenfabrik (Metal Filament and Glow Lamp Factory), and with a share capital of 1,000,000 kr., of which the sum of 900,000 kr. has been paid for the patents. At the same time, the Westinghouse Co. takes over to a large extent the patent in Vienna for the manufacture of osmium lamps in order to be able to place the wolfram lamp on the market from the Austrian capital. It is stated that the Johann Lux process is entirely suitable for the production of osmium lamps, so that the manufacture of wolfram lamps can be at once undertaken on a large scale. The company is credited with the intention, in order to distribute the lamps quickly, of concentrating its attention on the manufacture and drawing of the wolfram filaments, and of leaving them to the glow lamp factories to fix in the glass bulbs. It remains to be seen what action will be taken by other owners of wolfram lamp patents as a result of the new step initiated by the American Co. These patents are held, among others, by the German Incandescent Gas Light Co., of Berlin, in regard to the Osram lamp, and by the United Electricity Co., of Buda-Pesth, in relation to the lamp devised by Dr. Just and F. Hanamann, of which the patents for the latter have partly been disposed of to the German Wolfram Lamp Co., of Augsburg. It is stated that further experiments with the Johann Lux lamp have served to confirm the favourable results obtained earlier, although the disadvantages in regard to pressure and sensitiveness of the filament have not yet been overcome. The consumption of energy is declared to average scarcely one-third of that of the carbon filament lamp while having the same useful life, and the cost of production is only very slightly higher than the latter.

Catalogues and Lists.—Messrs. Crompton & Co., Ltd., London, E.C.—New pamphlet (U16) describing, illustrating and pricing their portable testing sets (combined voltmeter and amperemeter).

The Vortex Pulley and Belting Co., Tower Royal, E.C.—Circular setting out in tabulated form prices of B.B. wood-split pulleys, ranging from 3 in. to 25 in. width of face, and from 3 in. to 96 in. diameter.

Messrs. J. H. Butcher & Co., Steelhouse Lane, Birmingham.—Small booklet, entitled "Hints to Advertisers," setting out the advantages of Solito translucent window transfers, window tablets and transfers as an advertising medium.

Messrs. W. H. Roy & Co., 30, Spring Gardens, Manchester.—Eight pp. pamphlet, describing their Standard water coolers. Some illustrations appear of plants recently erected by them, including an open cooling tower with the "Roy" patent stack, for a duty of 50,000 gallons per hour, and a chimney draught cooling tower with Roy stack, for a duty of 90,000 gallons per hour.

Messrs. Joseph Adamson & Co., Hyde.—Pamphlet relating to the durability of electric travelling cranes, showing the relative proportion of important wearing surfaces in their own and other makers' designs. A standard list is tabulated of electric cranes for from 3 to 100 tons working load, constructed by the firm.

Messrs. Griffiths Bros. & Co., Bermondsey.—Priced circular, with specimen colours, of their "Anti-sulphuric" enamel for metal and wood protection, as used for accumulator rooms and other electrical purposes, also in chemical factories, in the mining industry, &c.

Messrs. Johnson & Phillips, Ltd., Charlton.—General catalogue, which consists of copies of various price lists (8½ in. × 11 in.) all brought together in a stiff binder, admitting of the addition of later lists as issued. Descriptions accompanied with half-tone illustrations, tabulated sizes, speeds, capacities and prices of the following are given: Direct-current dynamos, motors and motor-starters, main switches, alternating current transformers, permanent magnet and hot-wire ammeters and voltmeters, switchboards, electric arc lamps, feeder pillar and junction boxes, also vulcanised and vulcanised india-rubber cables and wire. The whole of the lists are very finely printed and well set out. Copies will be sent to anyone interested.

The A.E.G. English Manufacturing Co., Ltd., London, W.C.—New price list (36 pp. 8½ in. × 10 in.) of Nernst electric lamps. General descriptive matter is followed by a note on their advantages and instructions for fixing together, with a diagram of connections. The various types of these lamps for indoor and outdoor lighting are well shown, and a number of special globes, as well as various reflectors and accessorial parts are included. In this list special attention is drawn to the fact that Nernst lamps for circuits below 200 volts are *not* recommended, therefore particulars of candle-power of low-voltage circuits have been omitted altogether. We understand that on circuits of 200 volts and above, the lamps give excellent results, both on direct and alternating, but the frequency should be at least 50 periods on the latter supply. Nernst lamps for street lighting have been supplied to over 100 electric lighting stations.

The British Thomson-Houston Co., Ltd, Rugby.—Attractive pictorial card in colours, representing the present-day user of "B.T.-H.-Edison electric lamps, made in Rugby," summoning "from the shadowy past," as Longfellow has it, the "forms (of illuminants) that once have been." Seated comfortably under the perfect and shadowless light of a B.T.-H. lamp, the twentieth century reader lifts his eyes from his evening paper to see not far away figures of a bygone age bearing old-time watchman's street lamps, torches, candles, and—there is even a gasolier! In this card these figures seem to recognise their powerlessness to eclipse the up-to-date form—they show no fight.

Messrs. Drake & Gorham, Ltd., Westminster, S.W. (on behalf of the Jandus Arc Lamp and Electric Co., Ltd.)—Copy of their catalogue (No. 114, 12 pages, 6 in. × 9½ in.) of Jandus arc lamps for the current season. Brief essential particulars of the different types, also neat illustrations and a statement of prices are given. The types included are the single enclosure, twin-carbon, universal, inverted, Midget, flame, and photo. lamps. A list of prices of spare parts appears.

Electrician Sentenced.—At the Central Criminal Court last week Charles Jefferson Dudley, *alias* Charles Jefferson, aged 30, described as an electrician, was sentenced to 12 months' hard labour for having obtained money under false pretences. It appears that he had traded as an electrical and surgical appliance maker, and had advertised for canvassers, who had to deposit money as security (£70 was obtained in April and May last), but who received no salaries, though such were agreed upon. Prisoner claimed to be the inventor of a portable electric lamp for medical purposes, but he had no patent for it.

Annual Outing.—The office staff of Messrs. Ellis and Ward, electrical engineers, held their annual picnic on Saturday last, going by special saloon to Stratford-on-Avon, where they were catered for at "The Swans' Nest." During the morning a cricket match was played on the Stratford Club's ground, the rival captains being Mr. C. W. V. Clarke, clerical department, and Mr. E. Marples, engineering department. The latter's team were easy victors, knocking up 103 runs in less than an hour. After a river trip, tea and a smoking concert, at which a vote of thanks was accorded to the principal, Mr. H. Willoughby Ellis, the party returned by saloon to Birmingham.

Threatened Strikes.—It is reported that 200 men employed by the Brush Electrical Engineering Co., Ltd., at Loughborough, have given in their notices. They ask for increased wages and for a reduction in the number of boys employed, and they are supported by the Carpenters' Union.

It is also stated that a lengthy struggle is expected between masters and men in the Clyde shipbuilding and engineering trades, the Employers' Federation having refused to discuss compromise or submit the men's claims to arbitration. According to the *Financial Times*, the men will quit work to-morrow.

The *Rochdale Times* has the following paragraph:—"The dispute which has arisen at the Rochdale Electric Co.'s works, Shawclough, through the Amalgamated Society of Engineers desiring to bring within the union a number of men employed there on special work, is still unsettled, the efforts to bring about a conciliation having failed. We understand that the terms offered by the firm have been refused by the operatives' society, and that for the present negotiations are closed. The firm express a determination to fill the vacancies with new men."

According to the *Financial Times* a conference lasting nearly five hours was held in Manchester on Tuesday to consider the application of operative engineers for an advance of wages. "The men ask for an advance of 2s. a week for day workers and 5 per cent. for piece workers. The parties to the conference were representatives of the men and the Committee of the Manchester and District Engineering Trades Federation. No statement was made to the Press, but it is assumed there will be a settlement."

Trade Announcements.—Mr. William Middleton is retiring from the firm of Christy Bros. & Middleton, Chelmsford, and the business has now been registered as a private limited company in order to enable several members of the staff to take a financial interest in it. The business will be continued as heretofore, Mr. Frank Christy and Mr. Leonard Christy acting as managing directors; and Mr. Fred Taylor, of Chelmsford, will act as chairman of the company. The business is being extended in several directions, and a motor-car department, with good garage and repair facilities, has been added. The firm's chief energies will, however, be devoted, as heretofore, to electrical and hydraulic engineering.

The Lancashire Dynamo and Motor Co., Ltd., owing to the increase of their business in the Newcastle district, have decided to open an office of their own, and from October 1st. Mr. Hearne will represent them there. The office address is: Star Buildings, Northumberland Street, Newcastle-on-Tyne; telephone No. 1923.

Messrs. H. G. Mayer & Co., of 67, Aldersgate Street, E.C., wish it to be known that Mr. B. Listner, who has been connected with the Nernst Lamp Department of the Electrical Co., Ltd., London, W.C., for the last five years, has severed his connection with that firm, and will in future sell the same article on behalf of Messrs. Mayer, who have opened a special department for these lamps and can supply from stock any quantity required.

Mr. J. Moores has entered into partnership with Mr. William Martin, and the name and style of the new firm will be Moores, Martin & Co., and the address 37, Blackfriars Street, Manchester.

Bankruptcy Proceedings.—Ernest Rosenberg.—Under the failure of Ernest Rosenberg, formerly managing director of H. M. Salmony & Co., Ltd., electrical engineers and dealers in electrical accessories and fittings, and now a patent broker, of 465-6, Birkbeck Bank Chambers, High Holborn, the first meeting of creditors was held last week at the London Bankruptcy Court. Mr. Egerton S. Grey, Official Receiver, reported that it appeared from the debtor's statements that he came over from Germany in 1888, and for five years he acted as agent for his uncle, a Basinghall Street merchant. In 1893 he went into partnership with Mr. H. M. Salmony, and three or four years later, they converted the business into a limited company, registered as H. M. Salmony & Co., Ltd. The debtor acted as managing director of the company until 1901, when he resigned, the company having sold part of its business, and liquidated the remainder. He estimated that he lost £20,000 through his connection with that business. Since 1901 he had dealt in various patents and shares, and had been interested in the Briede Seamless Tube Co., Allsopp Patent Flour process, Karsam Soaps, and Bates & Peard Annealing Furnace. The statement of affairs had not yet been filed, but the debtor roughly estimated his debts at £8,000, three-fourths of the amount being due to family creditors, and the value of the assets had yet to be ascertained. Dr. Cruesmann (Cruesmann & Rouse) attended for the debtor, and suggested that the meeting should be adjourned until next April, by which time it was anticipated that there would be sufficient funds in the estate to pay all the debts in full. The chairman declined to grant any adjournment, and a resolution was passed for Mr. R. H. Stainforth, chartered accountant, 31, Lombard Street, E.C., to act as trustee and administer the estate in bankruptcy, with the assistance of a committee of inspection.

Robert Owen Thompson, electrical engineer, Dorset Gardens, Brighton.—Receiving order granted September 19th on debtor's own petition. First meeting to be held October 3rd, and public examination October 4th, both at Brighton.

Charles Leonard Ford, ironmonger and electrician (lately electrician), Market Street, Stalybridge.—First meeting, October 5th, and public examination, October 12th, both at Stockport.

George Aaron Benton, electrical engineer, Shareshill, Stafford, lately of Muswell Hill, Middlesex.—Last day for receiving proofs for intended dividend October 11th. Trustee, S. W. Page, 30, Lichfield Street, Wolverhampton.

Competition in Switzerland.—Swiss manufacturers are finding unfettered competition no greater benefit than have their English fellows. Speaking of the competition of German electrical engineering firms with those of Switzerland in supplying the equipment for the great Swiss hydro-electric works which have been launched in recent years, the *Neue Züricher Zeitung* remarks:—"We hold to the principle of free competition unrestricted by any nationality. But when we look towards Germany we sorrowfully observe that in official invitations and acceptances of tenders only German firms are considered. Hence it would not be unjustifiable to require that with Swiss official invitations and acceptances of tenders, only Swiss firms should be given consideration. This, which it must be confessed, is a somewhat narrow-hearted policy, is, however, not actually practised by us. Only when prices are equal are home competitors preferred. We must, however, be honest here, and confess that it almost always occurs that home firms get the contracts; this is easily explained by the fact that the competitors compete from a unity basis of prices, which, with the contemporaneous starting of the several firms, are usually nearly on a level."

Italy.—According to the *Revue Pratique de l'Electricité*, an opening exists in Naples for the sale of a good pattern of electric glow lamp, those hitherto offered locally, of German origin, being both of indifferent quality and dear in price.

Belgium.—The Union Anversoise de Tramways et d'Entreprises Electriques, of Antwerp, reports a profit of £41,116 for the last financial year.

Dissolutions and Liquidations.—Electrical Wool Pulling Syndicate, Ltd.—A meeting is to be held at 72, Market Street, Bradford, on November 2nd, to hear an account of the winding up of this company from the liquidator (Mr. N. R. Dickinson).

Edwards & Magnus, electric fittings manufacturers, Heneage Street, Birmingham.—Messrs. E. A. Edwards and H. Magnus, have dissolved partnership as from March last.

With reference to the notice concerning the The General Contracts Co., Ltd., which appeared in our last issue, Mr. J. Gordon Salamon, the manager, says that the statement that the company had liquidated, and that owing to its liabilities was unable to carry on business, is sure to be misconstrued. We understand that it was put in that form through a mistake of the solicitors; and we are asked to state that the creditors of the company have been paid in full, and that the business has been sold and will be carried on as hitherto, the liquidation being purely a matter of arrangement to carry through the sale.

New Accumulator.—"L'Energique" is the name given to a new accumulator for which many advantages are claimed. It is stated that it may be charged and its acid solution poured off without in any way disturbing the charge, which allows for easy transport, and a great reduction in weight for carriage. With or without its acid, it is said to retain its charge indefinitely, and it is claimed to be proof against short circuits. For exciting it requires a compound stick to be added to each cell, each of which sticks is capable of releasing a given portion of the charge, and when that has been consumed the cells retain the balance of charge until other sticks are added, to the full capacity of the accumulator. It is further claimed that the voltage is quite regular, and is maintained until the cell is fully discharged. The balance of energy remaining unused is always easily ascertainable, which makes it particularly suitable for medical, surgical, and any purpose where it is necessary to have energy always at hand. We are informed that a 35 ampere-hour cell will serve for ignition purposes for a run of 1,750 miles, and if used for lighting will light three 2½-c.p. 4-volt lamps for 30 hours with one charge. Each cell contains two peroxide of lead positive plates and a basket-shaped negative plate of lead and antimony. The plates are kept apart by means of a deep celluloid separator fixed to the bottom of the cell, the space being such as to render an internal short-circuit impossible. The whole is enclosed in a strong celluloid case, hermetically sealed at top, but with openings for filling and inserting the compound which are provided with suitable caps to prevent spilling. The sole agents are Messrs. Krupka & Jacoby, 61/62, Watling Street, London, E.C.

For Sale.—The Burgh of Kilmarnock is offering a Crossley gas engine, dynamo, &c., at the Dick Institute for sale. Some particulars will be found among our advertisements to-day.

LIGHTING and POWER NOTES.

Aberdeen.—On the recommendation of the Gas and Electricity Committee, the T.C. has resolved to apply to Parliament for a prov. order to extend the area of supply for electrical energy, so as to be co-extensive with that for the supply of gas by the Corporation.

Birmingham.—The official opening of the Corporation power station in Summer Lane, is to take place on October 10th. The ceremony is to be performed by the Lord Mayor.

Brighton.—The T.C. on September 20th decided by 26 votes to 16 not to rescind a recent resolution deciding to open central premises as a showroom, &c. It was contended that the opening of a showroom would interfere with the electrical contractors who carried on business in the town, but it was pointed out that the Council had no power to supply fittings or do wiring work.

Continental Notes.—Spain.—According to *l'Industrie Electrique*, the number of public and private electricity works in existence in 1904 was 1,151, having a total capacity of 99,514 kw.; this gives an average of 86·5 kw., so that many of the installations must be very small. The output is mainly for lighting. There are three power transmission stations, of 1,487 kw.; eight traction stations, of 6,347 kw., and the rest, including 356 private plants, are devoted almost entirely to lighting and power. There is enormous scope for electrical development in the country.

Austria-Hungary.—The four communes on the Stanzer Valley in the Tyrol (Nassereit, Pettnau, Fliesch and Strengen) have combined to erect a power station for common utilisation.

Italy.—A concession has been granted for the erection of hydro-electric works on the River Aso for the production of electrical energy for public and private lighting in the seaboard district of the Adriatic embraced between Porto San Giorgio and Grottomare.

Numerous minor hydro-electric stations are being established throughout Italy, almost daily, for a variety of industrial purposes. Among others, the Society Contificio Francesco Turati has received sanction to erect a station at the waterfall of Dezzo, Mazzunno, for the production of 7,962 h.p. for the working of the cotton spinning mills now in course of construction at Cogno Borno.

France.—A recently-formed syndicate has purchased the Guillestre electric works with a view to the erection of an installation sufficient to light all the communes in the valley of the Durance from Guillestre to Chorges.

Two schemes are mooted for the electric utilisation of the waters of the River Ain, the one contemplating the erection of a station at Bolozon and the distribution of electricity to Bourg and the vicinity, and the other the erection of a hydro-electric station at Miribel, near Lyons, the waters of the Ain being brought thither by means of a canal to be constructed.

Belgium.—La Société Electrique de Vielsalm has just been formed at Vielsalm, with a capital of £2,400, to establish an electric lighting station in the town.

Germany.—The Communal authorities of Vulsken, near Hanover, have decided to erect an electricity works at a cost of 40,000 marks.

Sweden.—The Magnet Electric Co., Ltd., has decided to take over the Holmia Electric Co., Ltd., and Adolf Unger's Industrial Co., Ltd., and to increase its share capital to a minimum of two million and a maximum of six million kroner.

Cheltenham.—It will, perhaps, be remembered that in October, 1904, Mr. James Swinburne was called upon by the Corporation to report on the financial condition of the electricity undertaking. The accounts for the year ended March 31st last have been recently issued, and from them we are glad to note there is an improvement in the working. Considering the number of lamps, it must, however, be admitted that the revenue received from public lighting is somewhat high. The undertaking is considerably handicapped with a heavy accrued deficit. In regard to the latter, a loan of £18,457 was authorised under a prov. order of May, 1905, to meet this. The debit balance at March, 1905, amounted to £16,869. Financial charges amount to considerably more than the total working costs, and we agree with Mr. Bache, who, in his report, says that the Lighting Committee should obtain more information as to these charges, by asking the Finance Committee, who appear to control this matter, for a detailed statement, or that the Lighting Committee should have a separate banking account for the undertaking. The following figures relate to the year's working, ended March last:—

Revenue from private lighting and power, &c.	£9,801
Revenue from tramways	3,836
Revenue from public lighting	8,924
Revenue from meter-rents, &c.	1,016
Total	£23,576
Working costs, including public lighting and management charges	10,189
Gross profit, less bad debts	13,342
From G.D. Rate for interest and repayment of deficit loan	1,370
Sinking fund	3,991
Interest (including deficit loan and bank) charges	8,148
Balance, not allocated	2,573
Capital expended	£154,074
Units sold, private and contract	502,551
Units sold, public lighting	623,363
Units sold, traction	575,456
Total	1,701,370
Number of public lamps	383 arcs, 21 inc.
Maximum load	1,316 k.v.a.
Capacity of plant	1,980 kw.
Average price obtained, Private supply	4·68d.
Public lighting	3·43d.
Traction	1·6d.
Total	3·32d.
Total working costs	1·43d.

Crewe.—The borough treasurer has reported a surplus of about £4,000 on the electric light undertaking, and the Finance Committee has decided to invest £3,000 of the sum.

Dalkey.—The U.D.C. has received a communication from the Irish Electrical Agency, Ltd., in reference to a proposal to promote a Bill for the public and private lighting of the coast towns between Blackrock and Killiney. The Council of the latter place suggested that before any steps were taken there should be a meeting of the representatives of Dalkey and Killiney. The Finance Committee is to report on the subject.

Dunfermline.—The T.C. has again decided to open negotiations with the Fife Electric Power Co., to ascertain the lowest terms on which that company would agree to supply the burgh with electricity in bulk.

Erith.—Specifications and plans, prepared by Messrs. Hawtayne & Zeden, for water softening and purifying plant, &c., and the re-arrangement of condensers, pumps, &c., at the electricity works, have been approved by the U.D.C., and it has been decided to apply to the L.G.B. for sanction to a loan to cover the estimated cost of the works.

Exeter.—The Exeter Trades Association will hold an electrical and industrial exhibition in April next; and the E.L. Committee has recommended that in consideration of the syndicate giving the Council space in the Exhibition Hall, energy for not exceeding 300 8-c.p. lamps shall be supplied free of cost.

Falkirk.—The T.C. has reduced the price of energy for lighting purposes from 4½d. to 4d. per unit. As to power, the price will remain as at present, but consumers who install motors to the aggregate of 15 kw. or over will have the option of being charged at the rate of £2 10s. per kw. installed and ¾d. per unit for energy consumed.

R.M.S. "Mauretania."—The new quadruple screw turbine Cunarder, launched on the 20th inst by Messrs. Swan and Hunter and Wigham Richardson at Wallsend, and which will be the largest vessel afloat, has some special electrical features in its construction. Electric lifts are provided for the conveyance of passengers, as well as electric baggage and other lifts; a complete telephone system gives communication between the state rooms and the pursers' offices, &c. A very complete electric light system, and electric power installation for driving the fans, both in the engine rooms and passengers' quarters, will be provided. Nearly 5,000 electric lights will be fitted throughout the ship, there being about 200 miles of mains installed.

Hornsey.—Mr. Norman Staniland, the borough electrical engineer, has arranged for the holding of an electrical exhibition at the Christ Church Schoolroom, Crouch End, from October 2nd to 6th inclusive. The opening ceremony will be performed by the Mayoress of Hornsey.

London.—Kensington.—In a reply to a communication by the L.C.C. asking if the B.C. would be prepared to support the Spring Gardens authority on the question of regulating the opening up of streets, the borough engineer has expressed his opinion on the subject, and takes a more sensible view of the matter than the county authority. He expressed the opinion that it would be undesirable that work done by statutory authorities in London should be carried out simultaneously, as many of the principal thoroughfares in the Metropolis would be annually barricaded at the same time. He further pointed out that if a certain period in the year were arbitrarily, fixed during which any company or authority might open up streets, some saving clause would have to be inserted to provide for the opening up of roads in cases of emergency, and that it would be found in practice that fully 90 per cent. of the work would prove to be "emergency" work. It was, however, suggested by the borough engineer that useful legislation might be promoted to strengthen the hands of the Metropolitan B.Cs. in supervising and controlling the works carried out by statutory companies, provision being made by such legislation for the framing of regulations to deal with the following matters, viz.: (1) The position, depth and direction of mains; (2) the maintenance of the surface at the expense of the company for a period after the surface has been disturbed by such company; (3) the time during which intended works may be carried out after reasonable notice has been given by a B.C. to a statutory company, of such Council's intention to renew the surface of given streets. The Works Committee has concurred in the views of the borough engineer, and a communication embodying the substance of the report is to be addressed to the L.C.C. in reply to its letter.

Fulham.—With reference to the B.C.'s application to the L.C.C. for sanction to borrow £17,328 for E.L. purposes, the suggestions of the latter body, that the period of repayment should be reduced from 42 to 30 years, and the amount decreased by £3,327, have been agreed to.

Greenwich.—The town clerk has been instructed by the B.C. to ask Major Cardew, of the firm of Messrs. Preece & Cardew, whether he would be prepared to advise and report to the Council on the question of purifying the atmosphere of the sewers by means of ozone, electrically produced, for a fee of £50.

Hackney.—The Works and General Purposes Committee has agreed, in consequence of the decision to substitute flame arc lamps for ordinary arc lamps in the extension scheme now being carried out, to pay £12 per year for each lamp, instead of £11, as previously arranged. The borough electrical engineer has reported that flame arc lamp carbons are more expensive than those used in the white arc lamps, and owing to the greater complication of the lamps, their maintenance costs a little more, but, in view of the greater illuminating effect, the Committee has adopted the flame arcs for the 105 lamps about to be erected, though it will involve an additional total expenditure of £147 per annum, or about 10¾ per cent. above what would have to be paid for ordinary white arcs.

Poplar.—Application is to be made to the L.C.C. for a loan of £500 for wiring consumers' premises. The engineer reports an increase in the output during the five months to August 31st, over the same period of last year, of 352,095 units, the figures being 1,269,922 units, as against 917,827 units in 1905.

Camberwell.—At a special meeting of the B.C. on Wednesday, the Works Committee brought up a report, recommending that a memorial be sent to the B. of T. asking for a prov. order to supply electricity for public and private purposes. Three deputations attended against the scheme, and handed in petitions signed by nearly 6,000 ratepayers in support of their view. After a heated discussion, the Mayor ruled the report out of order on a point of municipal procedure.

St. Pancras.—The estimates of the Electricity Committee for the half-year to end March 31st, 1907, show a total expenditure of £37,270, and an income of £45,100. The chairman of the Electricity Committee circulated his annual report last week. From this it appears that the number of additional consumers connected during the 12 months, was 268, making a total of 2,763, representing a demand of 97,329 (16-c.p.) incandescent lamps, 1,197 arc lamps, 545 motors, and 548 amperes for cooking and heating pur-

poses. The total units sold during the year were (exclusive of public lighting) 5,047,974, and realised £59,997, equal to 2·85d. per unit sold. The profit during the year was £9,441, as against £13,098 in the preceding year, and £20,583 in 1904; 37 additional arc lamps were erected during the year, making a total of 792 arcs; 43 Nernst lamps have been erected in some of the by-streets. A letter was received from Messrs. Parsons & Co., asking that an arbitrator should be appointed to settle disputes in regard to their contract for turbines with the Council. The matter has been referred to the Electricity Committee.

The Guardians have decided to postpone further action as regards substituting electric light for gas in the workhouse.

In the annual report of the Baths Committee it is stated that there is a saving of £120 in the cost of electric driving at the Whitfield Street Baths as compared with steam working. It is expected that a substantial saving will also be effected at the King Street Baths, where electric motors have just been substituted for the old machinery.

Marylebone.—The Electric Supply Committee has approved of a scheme submitted by the resident engineer for keeping the cost of generating electricity as low as possible, by means of a bonus to be given to the men employed at the station. The scheme is being tried during the present quarter and will be continued during the December quarter. The total number of units which will be generated during that time is estimated at 4,500,000, and the bonus is to be paid on the ascertained works cost of units sold, the repair cost of plant to be included. The average cost per unit for the period under review would be approximately ·54d., but with the bonus scheme in force it is anticipated that this figure will be reduced to ·44d. This saving will mean, roughly, £1,900, of which £200 will be paid in bonuses to the men. The bonus is to be paid to those persons only engaged in the actual generating of the supply. Employés discharged for insubordination will forfeit all rights to the bonus, but any man discharged for slackness or who leaves to better himself will obtain the amount due to him.

Londonderry.—Last week the Law Committee of the Corporation presented a report, which stated that it had adopted a resolution asking Mr. Balfour, representing Messrs. J. G. White and Co., to make a definite offer to the Corporation for the purchase of the undertaking, and to state what tramway system he would be prepared to lay down, and what prices he would be prepared to fix for the supply of private and public lighting. This was put to the meeting and agreed to by a majority of 14 to 12.

Mexborough.—The U.D.C. has reduced the price of energy for private lighting from 4½d. to 4d. per unit.

Port Glasgow.—Negotiations have been opened by the T.C. with the Greenock Corporation to ascertain whether or not the latter can arrange to supply Port Glasgow with electricity for lighting and power purposes. The burgh electrical engineer of Greenock has been instructed to report on the probable cost of extending the electricity supply to the neighbouring burgh.

Portsmouth.—The new generating station which has been erected at Portsmouth Dockyard was formally opened by Rear-Admiral Sir H. D. Barry, the Admiralty superintendent, on the 15th inst. In addition to providing power for the whole of the dockyard, the new station will eventually supply energy for Whale Island (the gunnery establishment) and the Royal Naval Barracks. It is also intended to run a very large amount of the machinery in the yard by electric power.

Selby.—The U.D.C. on September 20th decided to apply to the B. of T. for an E.L. prov. order.

South Africa.—Transvaal.—The Krugersdorp T.C. has approved of the electric lighting scheme, which will be submitted to the Government for confirmation. If it is passed, tenders will be invited for carrying out the scheme. The promoters of the private Draft Ordinance (electrical concession) have notified the clerk of the Legislative Council that they do not intend to proceed with it during the present session.

A new power distribution scheme for the Rand has been suggested by Mr. McMullen, who says that the company which first puts down a large gas-producing plant at any colliery within reasonable reach, and runs pipes to a series of gas power electrical generating stations along the reef, will reap a rich harvest.

Natal.—As a result of the general movement for retrenchment, Mr. Stobies, the Harbour electrical engineer, Durban, has been requested to send in his resignation. Henceforth the Harbour will receive its electrical energy for lighting and power from the central power station at the railway works. The Harbour electrical installation has proved a most expensive one. Originally it was a small plant for lighting only, and it has been gradually added to piecemeal as requirements increased.

South America.—The scheme for the utilisation of the waters of Lake Titicaca for electrical purposes conceived by Prof. Emile Guarini, of the Ecole des Arts et Metiers, of Lima, is on a grand scale. Lake Titicaca is the highest navigable lake in the world, standing at an altitude of 3,800 metres above sea level; it has a superficies of 6,630 km., and contains a volume of water amounting to 503,880 billion litres, equal to a potential energy of 21,308,134 H.P.-years. It is situated partly in Peruvian and partly in Bolivian territory, being drained by the Bolivian river Desaguadero, which feeds Lake Pampas Aullagas, situated at the lower altitude of 2,655 m.; the latter lake is again drained by a smaller river whose waters, discharging a volume of only 1 metre cube per second, are mostly lost in evaporation and infiltration in the pampas. Prof. Guarini's scheme contemplates saving the volume of water lost by evaporation and infiltration by tapping Lake Titicaca direct, the waters thus obtained, after being made to generate electricity by means of turbines at several artificially constructed falls, being finally used for irrigation purposes in the Peruvian coast lands. Before this is achieved, however, considerable physical difficulties have to be surmounted, for Lake Titicaca lies at the bottom of an amphitheatre of mountains 250 m. high, and its waters will have to be withdrawn thence by a tunnel through the Andes. It is estimated that a volume of water of 100 metres cube per second can be transported over the 150 km. distance between the lake and the Pacific Coast, and used for the generation of 5,000,000 H.P. theoretical, or 2,000,000 H.P. effective, for the working of railways and mines, for use in industries such as electro-metallurgy, electro-chemistry, nitrate manufacture and agriculture, for electric telpherage, river and lake navigation, lighting of towns and villages, &c. The scheme being laid on unusually broad lines, the hydraulic installations will be on a scale exceeding anything hitherto practised, and the use of turbines of greater power than the 13,000 H.P. employed at Niagara, and of pressures surpassing the 60,000 volts used in California, is contemplated. A rough calculation of the cost of installation works out at 200,000,000 fr., or 100 fr. per horse-power effective, or 40 fr. per horse-power theoretical installed, and the undeveloped natural and industrial resources of Peru are said amply to justify the expenditure.

South Wales.—A meeting of consumers and prospective consumers of electrical power in Glamorgan and Monmouthshire was held recently to consider proposals which had been made by the South Wales Electrical Power Distribution Co. for amended terms on which the company is prepared to supply power. As a result of discussion, a committee of representative consumers was appointed to confer with the committee of debenture-holders of the power company with a view to discussing the terms proposed.

Southampton.—The Electricity Committee has recommended the T.C. to adopt the following new scale of charges for energy:—General rate for all consumers, 4d. per unit; for over 17,000 units used during the March and June quarters taken together, or September and December quarters taken together, 2½d. per unit; beyond, 2d. per unit.

Stourbridge.—In regard to the proposed transfer of the Council's E.L. prov. order to the Shropshire, Worcestershire and Staffordshire Electric Power Co., the draft deed of transfer, as amended by counsel upon the instructions of the B. of T. in the Council's favour, has been adopted by the Council.

Wallsall.—The T.C. has received sanction for a loan of £1,000 for electricity purposes.

Wellington (Salop).—Subject to the consent of the B. of T., the U.D.C. has decided to transfer its E.L. order to the Shropshire, Worcestershire and Staffordshire Electric Power Co., which undertakes to pay £100 towards the cost of obtaining the order.

TRAMWAY and RAILWAY NOTES.

Australia.—Adelaide.—A Bill has been presented to the South Australian Legislative Assembly by the Premier for the purchase and electrification of the present horse suburban tramway system. The agreement between the different tramway companies and the Government, providing for purchase for the sum of £280,000, has been ratified. The undertakings purchased are to be vested in a trust composed of six members, two being appointed by the Government, two being elected by the City Corporation, and two by the suburban Corporations. Within three years from December 31st, 1906, the trust is to complete a system of electric traction between Adelaide and its various suburbs, and further extensions are to be carried out as soon as these lines are shown to be profitable. The Government will, in the first place, finance the whole scheme. The gross receipts are to be applied to paying working expenses, and providing a renewal fund at the rate of 2½ per cent. on the capital cost of renewable parts, and the balance is to be handed to the Treasurer for meeting interest and sinking fund charges. Surplus moneys are also to be dealt with by the Treasurer. If, after five years, the enterprise does not earn sufficient to pay interest and sinking fund on the debentures, the Government may foreclose and take it over. The liability of the various municipal authorities for the debentures is distributed by Adelaide taking half and the remaining half being shared between the suburban Corporations. When the Government advances are repaid, the assets of the trust are to belong to the Corporations free from Government control. The Bill also confers on the trust powers to supply energy for electric lighting and power. The existing agreement between the Corporation of Adelaide and the South Australian Electric Lighting Co., which expires in 1908, is, however, safeguarded. The right to compulsory purchase of the company's undertaking is conferred on the trust. The trust has actually a monopoly to use electric tramways within a 10-mile radius of the G.P.O. The tramway construction is to be done by contract, but no contract is to be made without the consent of the Governor. Exception from taxation is granted.—*Australian Mining Standard.*

Cheshire Lines.—A Lancashire correspondent says it is reported that the Cheshire Lines Committee intends electrifying its line from Manchester Central to Wigan through Urmston, Flixton, Islam, Glazebrook and Lowton.

Continental Notes.—Italy.—An electric omnibus service without rails on the overhead trolley system has been inaugurated between Spezia and Portovenere. The route, which follows the coast line, is very sinuous, with curves of 7 metres radius and numerous steep grades. The transmission lines consist of two copper wires, hung 5·50 m. above the ground in the same horizontal plane, at a distance of 35 cm. one from the other. The energy is supplied from the same central station that supplies the Spezia tramway system, at a pressure of 500 volts. The cars, of which two perform the service, are fitted with 4-h.p. continuous-current motors mounted on the back axle and directly driving the back wheels by means of clutches. The Cantono type trolley used has given every satisfaction, negotiating without difficulty curves of the smallest radius at a speed of 20 to 25 kilometres. The weight of the cars is about 1,500 kg.; they are electrically heated and lighted, and carry 14 persons. The controller allows of four speeds forwards and two backwards, as well as the electric brake, besides which last there is another mechanism worked by foot or hand. Each vehicle runs about 140 kilometres a day, and the consumption of energy does not exceed an average of 200 watt-hours, a moderate figure in view of the difficulties of the route.

The scheme for uniting Rome and Naples by means of an express electric railway has been on the board for several years, without anything practical being achieved. Now, however, according to the *Elettricista*, steps are being taken to give it realisation, the banking firm of La Cana having applied for a concession to carry out a scheme drafted by M. Pivetta. According to the stipulations, the concession will run for 70 years, when the line will lapse to the State without any pecuniary payment, the latter furnishing no subvention. The line will be 198 kilometres long, and it is proposed to cover this distance in 1 hour 40 minutes, 2 hours, and 2 hours 45 minutes, according as the trains are express, partly express, or to stop at all stations.

Spain.—A concession has been granted for the construction and operation of an electric railway between Sarria and Vallvidrera (Barcelona).

Poland.—Up till 1905 little was done in the application of electric traction to the tramways of Russian Poland. If the political troubles do not hinder it, however, an electric service will be inaugurated in Warsaw on October 1st. But to carry out the complete electric traction programme, which contemplates the extension to 35 versts of the present network of 28 versts, two viaducts will have to be built, and this work is not likely to be completed in the course of the present year. The installation of the electric light in streets not served by the tramways is also contemplated. —*L'Eclairage Electrique.*

Switzerland.—For the provision of tractive energy for its working, the company owning the Jungfrau Railway contemplates erecting an electric station on the Lütschine River at Berglauenen. The river is to be dammed with a view to purifying its waters from sand and mud. It is anticipated that this station will provide sufficient power to work not only the Bernese Oberland lines, but also those of the Wengern Alp.—*Zeitschrift für Elektrotechnik.*

Germany.—A society styled the Sächsische Elektricitäts und Eisenbahngesellschaft has been formed in Berlin for the construction of an electric railway from Hohenstein-Ernstthal to Olsnitz. The plans are already prepared for submission to the Royal authorities at Dresden, and work is shortly to be begun.

A concession has been granted to the city of Mayence for the construction of an electric railway from Mayence to Gonsenheim, and from Kastel to Kostheim, with the stipulation that both railways shall be working by January 1st, 1908. The concession lapses on June 1st, 1954.

Austria-Hungary.—A conference was recently held in Nauders between Austrian and Swiss officials on the subject of the junctions of the Rhœtrar Railway with the Tyrol line. Besides the Schuls-Martinsbruck-Nauders railway, consideration was given to the project of a railway over the Ofenberg. At its start the line lies 919 m. above sea level, rising to 1,973 m., and falling to 1,500 m. at Ferny, its total length being 52 kilometres. Electrical energy will be employed for its working, which will be obtained from the Etsch River.—*Schweizerische Bauzeitung.*

Ministerial sanction has been given for the preliminary surveys for two electric tramways in the district of Krynica.

Dudley.—An accident took place on the tramways on Saturday, the fusing of a controller on one of the cars causing considerable alarm amongst the passengers. Two of them left their seats, and in jumping off were injured.

Hong Kong.—In regard to the typhoon experienced in the neighbourhood on the 18th inst., the head office of the Electric Traction Co. has been informed by its manager that the service was resumed on September 19th, and that the damage to its property was small.

Rowley.—The Tramways Committee of the U.D.C. has considered a draft of the Dudley and District Light Railways (Amendment) Order, 1906, the application for which is being made by the Dudley Corporation, but it does not recommend any amendment of the present order. The Committee has also reported that a settlement has been effected with the Birmingham and Midland Tramways Co. with respect to the new tramway from Old Hill to Blackheath, and that there is left a balance of £2,904 upon the loan.

(Continued on page 503.)

MESSRS. RICHARDSONS, WESTGARTH AND CO.'S STEAM TURBINE DEPARTMENT.

Amongst the engineering firms of world-wide reputation who have made the North-East Coast share with the Clyde the distinction of being our most important centre of marine and general engineering, few, if any, are more widely or more favourably known than the firm whose name heads this column. With an engineering record founded upon shipbuilding and marine engine building, and an extensive connection with iron and steel works, shipping companies, &c., Messrs. Richardsons, Westgarth & Co., Ltd., were favourably situated for adding to their varied interests the business of electrical engineering, and to this end they formed an alliance about 10 years ago with Messrs. Brown, Boveri & Co., of Baden, whereby they were enabled to secure the benefit of the valuable experience gained by the latter concern, and to handle their business in this country.* When the steam turbine, a few years ago, made its unprecedented leap to the front, it was a natural step for the company to make arrangements with Messrs. C. A. Parsons & Co., of Newcastle-upon-Tyne, and also with Messrs. Brown, Boveri & Co., who were then large manufacturers of the Parsons turbine, to manufacture turbines under licence. This took place in 1903, when the existing works at Hartlepool were already well provided with work, and as the manufacture of steam turbines necessitates the use of special machine tools of the highest class, it was decided to erect new shops for this purpose. These were completed and work was started by the autumn of the same year.

The illustration on p. 499 shows part of the main turbine shop, which covers an area of 3,050 sq. yards, and provides accommodation for a large number of workmen. The adjoining boiler house and test room cover an additional area of 250 sq. yards. All the machine tools are electrically driven, the system employed being three-phase alternating at 200 volts, 40 cycles per second; the marine engineering departments of the works were electrically equipped on this system as long ago as 1897, and the generating plant was extended for the supply of power to the new shops.

The larger machines are driven by separate motors, while the smaller ones are grouped together and driven by line shafting. Thus there are one 50-h.p., one 25-h.p., and three 10-h.p. motors driving lines of shafting, and motors aggregating 85 h.p. are coupled direct to machine tools.

The shops are divided into two bays, which are served by overhead travelling cranes of 20 and 10 tons lifting capacity respectively. The larger crane is provided with a 20-h.p. motor for travelling, a 6-h.p. motor for traversing the crab, and a 25-h.p. motor for hoisting; the 10-ton crane is similarly equipped with motors of 15, 5 and 20 h.p. respectively.

The buildings are of steel-frame construction, extremely well lighted from the roof, and the walls are faced with white enamelled brick; ample space is available for extension to meet future requirements.

Besides a variety of lathes, shapers, drilling machines &c., of ordinary size and type, there is a large boring machine driven by a motor and fitted with a five-speed back gear; a view of this is given on the opposite page. There is also a planer large enough to deal with the castings for a 3,000-kw. turbine, special machines for boring out cylinders, key-seating machines, &c.

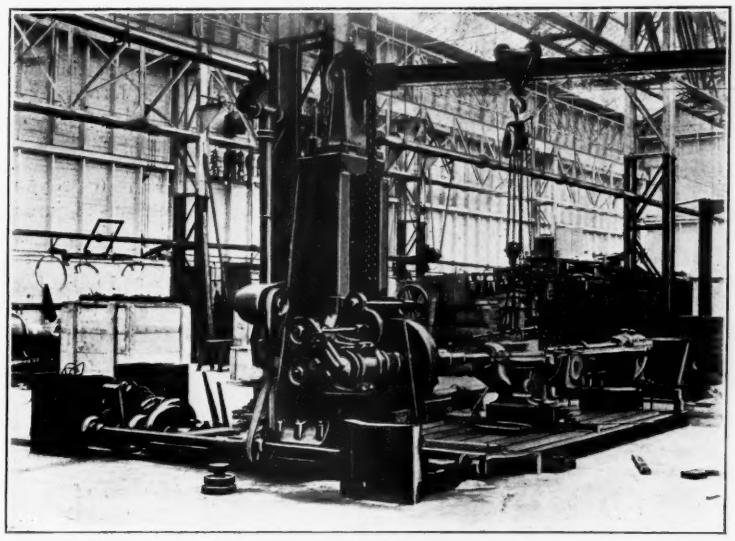
Separate departments are provided for tool and jig making, the manufacture of blades, and the blading of turbines. Interchangeability is a feature of the works organisation, and is strictly carried out.

The test room is equipped with Weston standard direct-reading instruments, with large open scales, and resistances capable of carrying 2,000 amperes—the latter consisting of condenser tubes through which a stream of water is passed; these are used in conjunction with two large Tudor storage cells for standardising purposes. Heavy copper bus-bars are connected with the machines on the test bed by

* In consequence of the formation of the English Brown, Boveri Co., in June of this year, the arrangement between Messrs. Richardsons, Westgarth & Co. and Messrs. Brown, Boveri & Co. with respect to the sale of their electrical material has now ceased.

underground cables, and with a large sea-water resistance outside the test room, which can be regulated by means of cords passing over pulleys from the test room.

The boiler plant consists of a "Nesdrum" water-tube boiler, with a separately fired Hornsby super-heater; the condensing plant is fixed underground, between the boiler house and the test bed. Due provision is made for weighing the condensed steam in carrying out the consumption tests.

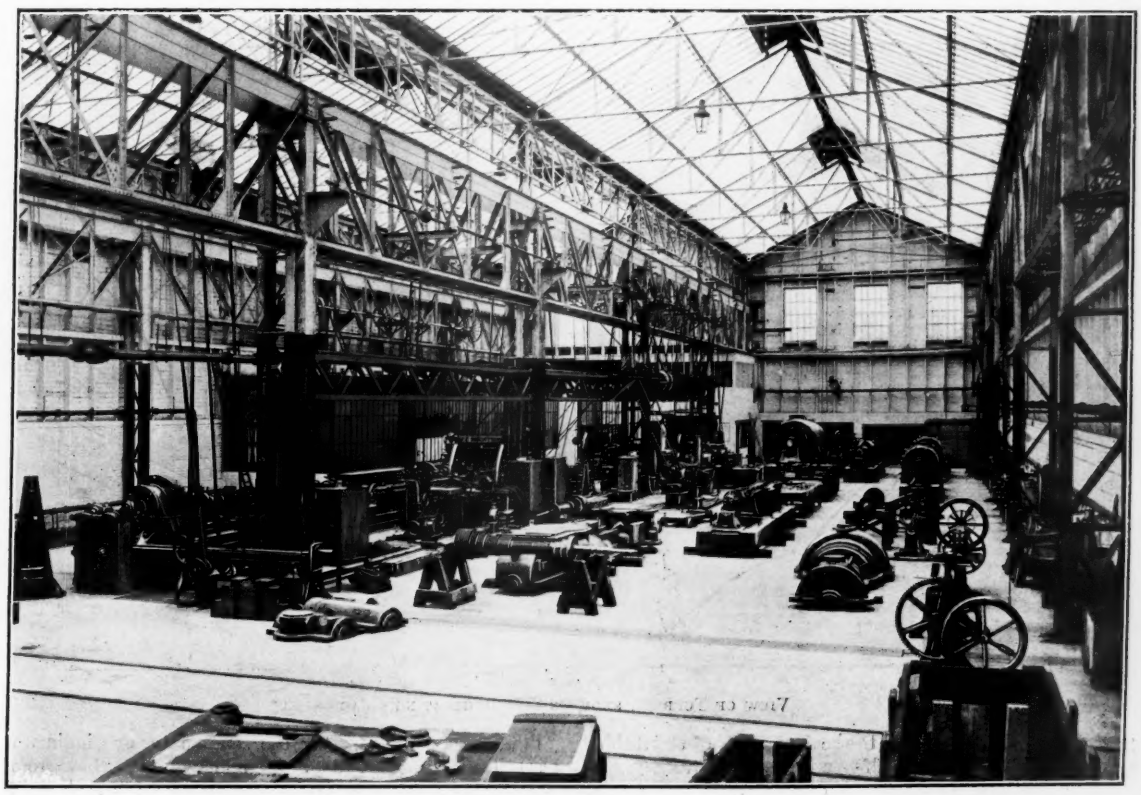


Large Boring Mill.

Amongst other turbines in course of construction at the time of our visit was a 600-kw. set destined for the extension of the works power station, which consisted of a turbine driving in tandem a 500-kw. three-phase alternator and a 125-kw. d.c. generator; the speed of the combination was 2,400 r.p.m., the frequency being 40 cycles per second.

The principal item of interest, however, was a turbo-dynamo just completed for the Lisbon Electric Tramways, Ltd., to the specification of Mr. Fearnside Irvine, consulting engineer to the company. This machine has an output of 1,000 kw., and runs at a speed of 1,250 r.p.m.; until recently direct-current machines of this type had been limited to a maximum output of 500 kw., owing to the difficulties experienced in securing satisfactory commutation. Messrs. Brown, Boveri & Co., however, who built the dynamo, have succeeded to admiration in this respect. So far as we are aware, no direct-current turbine-driven dynamo of a larger output than 1,000 kw. has yet been built in this country. At the time of our visit the dynamo was running with a load of 2,100 amperes (15 per cent. overload current) with reduced field, a condition which obviously constitutes a more severe trial of sparklessness than the normal condition; the field was reduced because steam was not available for the full output. The brushes were sparkless, and the commutator cool and bright.

The turbine embodies all the latest improvements of both Messrs. C. A. Parsons & Co. and Messrs. Brown, Boveri & Co. In combination with the generator it was guaranteed to consume not more than 18·5 lb. steam at full load, 19·8 lb. at three-quarter load, and 22 lb. at half load, when supplied with steam at 150 lb. per sq. in., superheated 100° F. at the stop valve, and exhausting into a vacuum of 28 in. with the barometer at 30 in. Preliminary tests have indicated that the performance of the set will be well within the figures of the guarantee, but the complete official tests will not be carried out until it is installed in its permanent position.



Interior of Part of Messrs. Richardsons, Westgarth & Co.'s Turbine Department.

The turbine is capable of carrying an overload of 25 per cent. for one hour at normal speed, without the use of the by-pass; but the latter will be fitted to enable the turbine to carry the normal load non-condensing.

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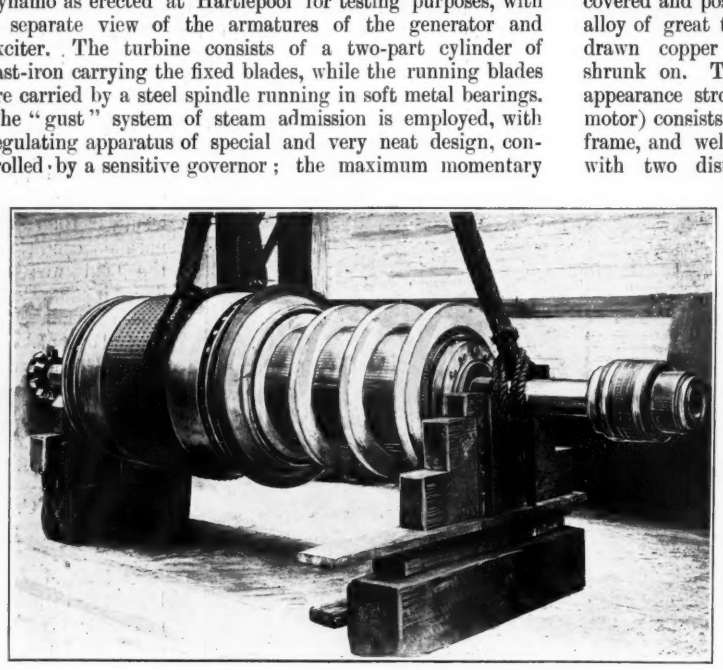
The accompanying illustrations show the turbine and the dynamo as erected at Hartlepool for testing purposes, with a separate view of the armatures of the generator and exciter. The turbine consists of a two-part cylinder of cast-iron carrying the fixed blades, while the running blades are carried by a steel spindle running in soft metal bearings. The "gust" system of steam admission is employed, with regulating apparatus of special and very neat design, controlled by a sensitive governor; the maximum momentary



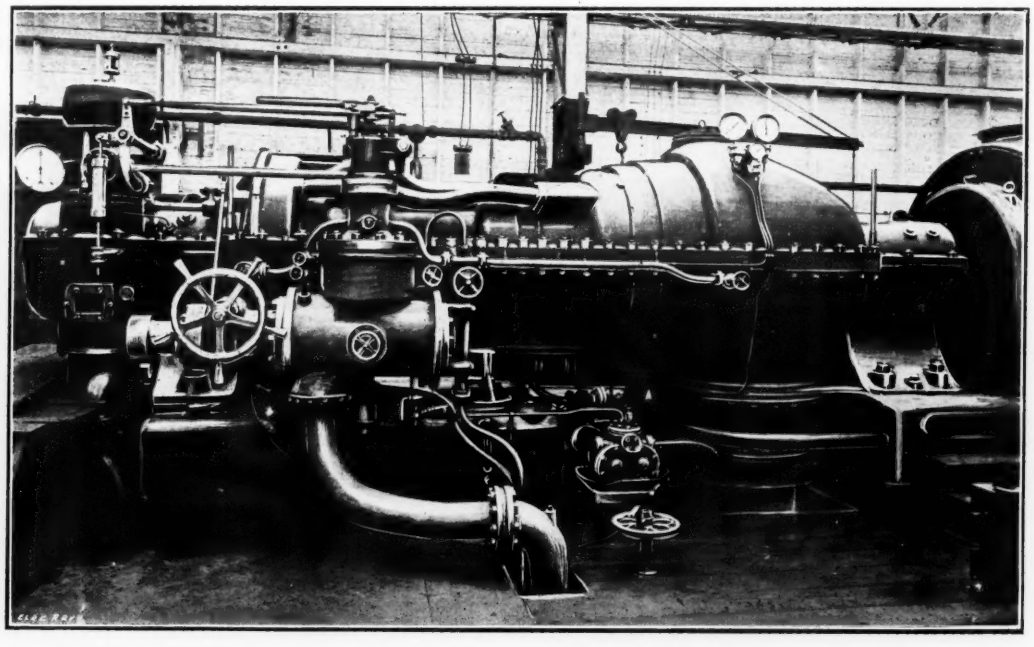
Generator and Exciter Armatures.

variation of speed with the whole load thrown off is not more than 6 per cent., and the permanent variation does not exceed 2½ per cent. Oil is forced to all the main bearings under a pressure of 20 lb. per sq. in. by a rotary oil pump, fixed on the vertical shaft of the governor, and drawing from a collecting tank; the hot oil passes through a cooler on its way to the turbine. An emergency governor is provided, which shuts down the turbine if the speed from any cause exceeds the normal by more than 10 per cent. All the governing gear is connected to the lower half of the turbine casing, leaving the upper half free for easy removal.

The dynamo is of Messrs. Brown, Boveri's patent compensated field type, having a normal output of 1,000 KW. at 550 volts, and overload outputs of 1,100 KW. for three hours, 1,200 KW. for one hour, and 1,500 KW. momentarily, all at 550 volts. The rotating armature is of the slotted drum type, with ample provision for ventilation; the windings are held in place in the slots by hard-wood wedges, while the parts of the windings overhanging the ends of the core are covered and positively held by metal caps cast from a special alloy of great tensile strength. The commutator, of hard-drawn copper and mica, is strengthened by steel rings shrunk on. The four-pole field-magnet system (which in appearance strongly resembles the stator of an induction motor) consists of soft-iron core plates carried in a cast-iron frame, and well ventilated. The magnet core is provided with two distinct windings—a shunt winding, and a compensating winding displaced from the former by an angle of 90 electrical degrees. The compensating winding enables the machine to work with the brushes fixed at all loads from 0 to 50 per cent. overload, without injurious sparking; at the same time, as it carries all or a part of the main current, it can be adjusted so as to give the dynamo the characteristic of a level compounded, over-compounded or under-compounded machine.

The dynamo is to run in parallel with existing slow speed machines in the Lisbon Tramways power station, and was required to have an over-compounded characteristic. Instead of making use of the above-mentioned feature of the compensating winding, Messrs. Brown, Boveri & Co. have provided a special compound winding, thus making the brush position independent of the compounding. In the case of the Lisbon generator a direct-coupled six-pole exciter is provided, giving 38 amperes at 100 volts, with the armature mounted on the end of the shaft. "Galvano" metallic brushes are used, with small morganite carbon pilot brushes set slightly in advance. There are 12 copper and six morganite brushes per pole in this particular generator.

The rotating parts were most carefully balanced, vibration being practically absent, and what little there was being traceable to the oil pumps, air suction, &c. The temperature limit of the hottest part of the commutator or windings was specified to be 45° C. above the temperature of the surrounding air, after a run of 10 hours at normal full load, and the insulation of the generator windings was tested to the frame with an alternating pressure of 1,100 volts. Forced ventilation is used, air being drawn from under the bedplate by vanes on the end of the armature spider, and discharged through an opening on the top of the frame after circulating through every part of the machine.



View of Turbine, showing the Regulating Gear.

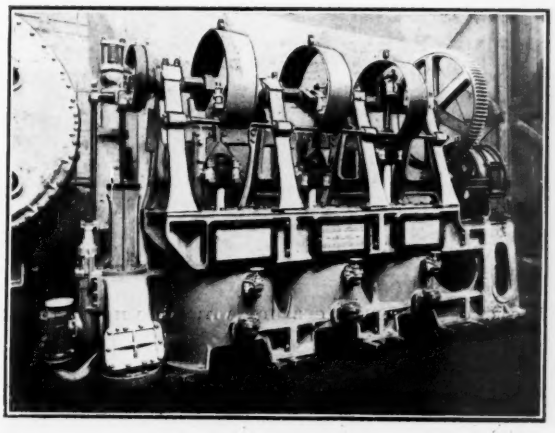
As we have already mentioned, the generator is provided with a direct-coupled exciter. The reason for this is as follows :—Suppose that for some reason or other the return-current switch does not cut off the return current ; then the turbo-dynamo will work as a motor, and has a tendency to race away altogether, the action of the dynamo running as a motor assisting the turbine in increasing its speed. The tendency to accelerate may become very considerable should the regulation of the dynamo be such that the dynamo is not perfectly compensated, because in this case the compensating winding may materially weaken the effect of the field produced by the main exciting winding.

If we have a direct-coupled exciter on the turbine shaft, the voltage of the exciter increases in proportion to the increase in speed ; consequently the exciter will absorb more energy, besides which the increase in the exciting voltage will strengthen the field produced by the shunt winding. These two factors, one mechanical and the other electrical, put a limit to any increase in speed, which increase also causes a larger return current.

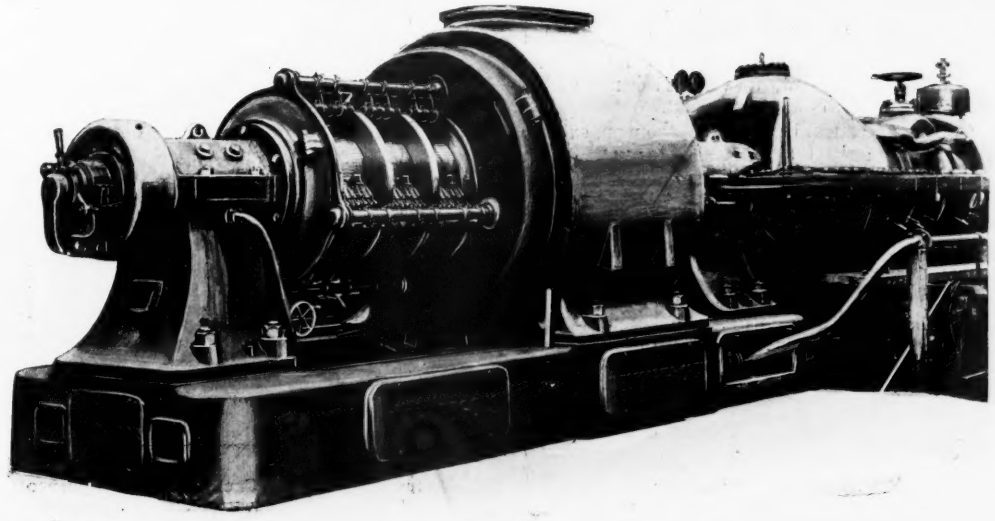
It will be seen from the above that the exciter means an additional security to the installation in case the return-current switch should fail to act. Messrs. Brown, Boveri and Co. consider this auxiliary safety device well worth the additional cost incurred by installing a separate exciter.

The turbine, as illustrated, is without the planished steel casing which was to be applied before dispatch. Noteworthy features of its construction were the simplicity and lightness of the frame, and the convenient arrangement of the regulator gear at the side ; the winding of the generator was also extremely neat, and far superior to many examples that we have seen of British manufacture.

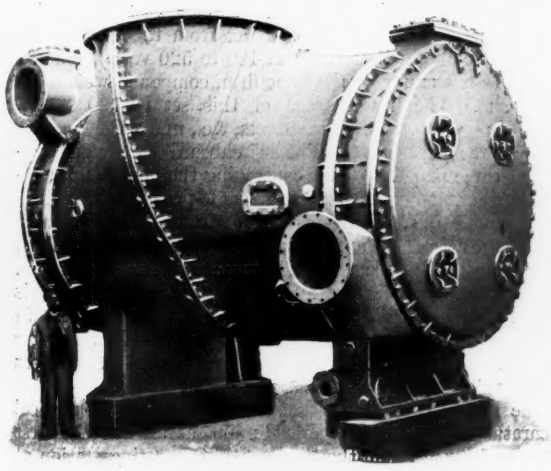
Taking advantage of the opportunity, we visited the older portion of the works, where marine engines, evaporators, condensers, air pumps &c. were in course of manufacture. Amongst the last named was some heavy condensing plant for Carville power station, where a similar condenser has already been installed. This condenser, which is of the "Contraflo" type, is shown in the accompanying figure, and is specially designed to produce the highest vacuum possible.



Motor-driven Air-pump.



Generator End of 1,000-kw. Turbo-dynamo.



"Contraflo" Condenser.

The interior is divided into compartments, which are traversed in succession by the exhaust from the turbine ; vapour and water are led separately, and in opposite directions from each compartment, the vapour and air passing on through the chambers, and the air ultimately going to a discharge outlet leading to the air pumps, while the water is drained into a small hot-well. By this means the temperature inside the condenser is reduced below that of the hot-well, while the water is returned to the boilers at a higher temperature than is usual.

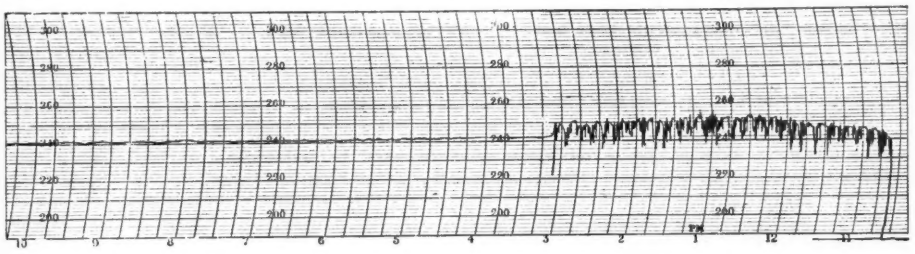
In addition to the Hartlepool Engine Works, Messrs. Richardsons, Westgarth & Co., Ltd., as most of our readers are aware, are manufacturing large gas engines at their works at Middlesbrough, being amongst the few British firms that early realised the importance of this branch of industry in connection with the utilisation of blast furnace gas. They have works at Sunderland also.

Mr. D. B. Morison is managing director of the Hartlepool Works, Mr. J. B. Willis the chief of the turbine department, and Mr. M. G. S. Swallow the chief of the electrical staff. We are indebted to these gentlemen for a courteous reception and willing assistance on the occasion of our visit to the Hartlepool Engine Works for the purpose of preparing this article.

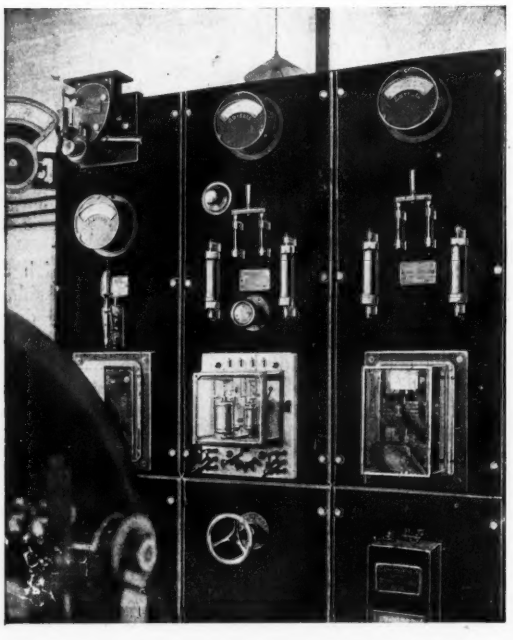
ELECTRIC LIGHTING FROM TRAMWAY FEEDERS.

In February of this year we described in some detail the Chesterfield Electric Lighting and Tramway undertakings, in connection with which reference was made to the proposal of Mr. R. L. Acland, the borough electrical engineer and tramway manager, to supply a certain outlying district through his tramway feeders. As this proposal has now taken definite shape, the following details will be of interest. The urban district of Whittington, lying outside the borough boundary, did not, until recently, possess the electric light; Mr. Acland, realising that it offered a possible source of revenue which would not involve any increased generator capacity, drew up various schemes with a view to providing a supply of energy.

The tramway route, as will be seen from the map, extends as far as Whittington; the lighting mains, however, end at approximately 1½ miles from Whittington, and the cost of new feeders from the generating station, Mr. Acland estimated at, at least £2,500, a sum too large to be considered, as the income from the sale of energy would not cover the outlay. Against this scheme was one of installing a sub-station near the end of the tramway line, and putting in a motor-generator fed direct from the tramway bus-bars through an existing tramway feeder, the supply to the overhead trolley line being tapped off this feeder through circuit breakers placed in a special feeder pillar.



Record of Pressure Regulation, with and without the B.T.-H. Voltage Regulator in Service.



Switchgear in Sub-station, showing the B.T.-H. Voltage Regulator.

As the pressure at this end of the line varies from 480 to 520 volts, some method of keeping the pressure of the motor-generator constant had to be determined upon, and it was decided to install in the sub-station a B.T.-H. voltage regulator.

This is the first instance in the United Kingdom, of the kind, and the results have fully justified the venture.

To demonstrate the possibility of regulating the pressure within 1 per cent., the engineer recently, when showing the sub-station to a visitor, moved the shunt rheostat controlling the speed of the motor, from the point with all resistance out to all resistance in, thereby speeding up the motor from 720 to 800 r.p.m., at the same time putting the full load on the generator, then reducing the speed and instantaneously pulling the load switch, thus throwing on and off the full load of the generator. The pointer of the voltmeter was seen scarcely to tremble owing to the rapid operation of the voltage regulator. With the regulator cut out, however, and the above performance repeated, the pointer of the voltmeter rapidly oscillated from 220 to 260 volts.

Special Tramway Feeder Pillar, Equipped with Circuit Breakers.

The electrical equipment of the sub-station consists of a B.T.-H. motor, which operates direct from the trolley wire (the voltage of which varies from 480 to 520 volts), coupled direct to a generator by the same firm, compound wound for 240 volts. The rated speed of this set is 790 r.p.m. Additional space, with cable ducts, &c., under the floor, is provided for another set. The switchboard at present consists of three panels; one for controlling the motor end, containing a circuit-breaker, ammeter, single-pole switch, starting rheostat and B.T.-H. wattmeter; a second is the generator panel, and carries an ammeter, double-pole switch and fuse, B.T.-H. voltage regulator and shunt rheostat for the dynamo. The shunt rheostat for the motor end is also placed on this panel; the third panel controls the feeder, and contains an ammeter, double-pole switch and fuse, B.T.-H. wattmeter and Elliott recording voltmeter, which is connected across the dynamo.

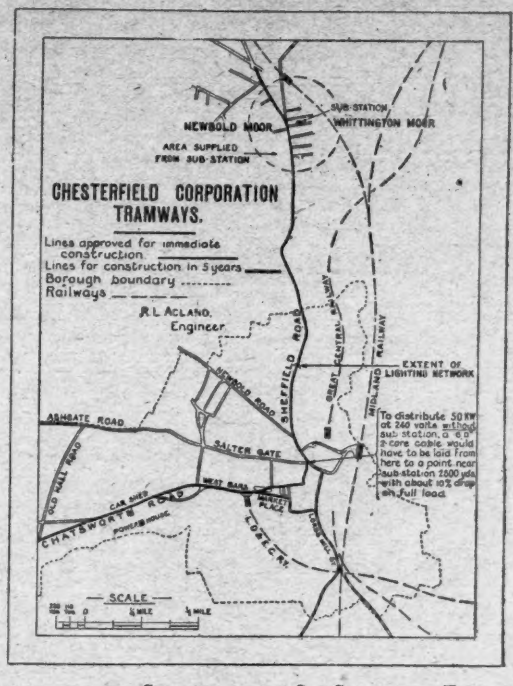
The entire cost for construction of building, electrical apparatus, &c., did not exceed £500, as against the first scheme of feeders from the Chesterfield generating station at £2,500, and a far better service has resulted with less voltage variation than could have been secured with the latter scheme.

The scheme could obviously be repeated in numerous localities with advantage; electric tramways in innumerable instances pass through isolated villages, and here any expensive scheme would be absolutely barred.

We understand that Mr. Acland is most satisfied with the

successful operation of his sub-station, the voltage curve at the latter being far better than that at the generating station.

The curve on p. 502, taken recently at the sub-station shows the voltages with the regulator in and out of circuit.



PLAN SHOWING THE SITUATION OF THE SUB-STATION AND TRAMWAYS.

The whole of the apparatus was supplied by the British Thomson-Houston Co., Ltd., of Rugby, to Mr. Acland's specification, and was erected by the Corporation staff, under the direct supervision of Mr. H. L. Percy, the late chief assistant engineer.

TRAMWAY and RAILWAY NOTES.

(*Concluded from page* 498.)

London.—ST. PANCRAS.—The B.C. has adopted the recommendation of its Parliamentary and General Purposes Committee to consent to the introduction of a Bill by the L.C.C. to authorise the construction of tramways by that authority in St. Pancras. The L.C.C. proposed that certain portions of the tramway route should be on the conduit system and other portions on the overhead system, but the B.C. decided to inform the L.C.C. that it adheres to the resolution passed in January, 1904, that it was desirable that one system only should be adopted throughout the borough, and requests the County Council to construct the whole of the lines in St. Pancras on the underground conduit system.

L.C.C.—It is reported that when one of the County Council tramway cars reached the top of the gradient at the Southampton Row end of the tunnel under Kingsway on Thursday last, the car, in restarting commenced to run back, and, in spite of all the brakes being put on, travelled at a great pace for a distance of 200 yards into the tunnel.

Manchester.—The Parcels Sub-Committee of the Manchester Corporation Tramways Committee met on Tuesday last to consider as to the future of the parcel-carrying enterprise. The parcels department has been conducted throughout under circumstances of great and unexpected difficulty, and has involved substantial loss. The sub-committee recorded its unanimous decision in the following resolution: "That, inasmuch as the present statutory powers of the Corporation are not sufficiently wide to enable the Corporation to successfully carry on a parcel-carrying business, this Committee is of opinion that immediate steps should be taken to confine the operations to the tramway area, so as to prevent a continuance of the loss which is at present being sustained. That the Negotiations Sub-Committee be empowered to take all necessary steps for giving effect to this resolution." Later in the day the resolution was confirmed by a full meeting of the Tramways Committee.

The Tramways Committee also decided, at its meeting on Tuesday, to commence without delay the laying of a tramway line to serve the growing and important suburb of Chorlton-cum-Hardy. A single line will be laid from West Point, the present terminus of the electric car service in that direction, to High Lane, by way of Barlow Moor Road. It is intended to make loops wherever convenient, and the single line will be laid throughout in such a position that when the Withington Committee has acquired land for the widening of the road, it will only be necessary to lay another line alongside to complete the route as a double-line one. By its action in this matter the Tramways Committee will put an end to a long-standing controversy.

For the 13 months ended August, there were only six fatal tramcar accidents in Manchester, notwithstanding that 450 cars travel along crowded streets, each an average of 100 miles a day. In 12 months the lifeguards have acted efficiently in 95 cases, and only twice have they failed.

Milnrow.—The U.D.C. has informed the Rochdale T.C. that it is prepared to apply for a prov. order for the construction of electric tramways through the district, from the present terminus at Firgrove Bridge. The idea is for Rochdale to construct and work the lines.

Rawtenstall.—Speaking at a recent meeting, Alderman Schofield said that land had been purchased at Hareholme for a generating station, and that "the cost of purchasing the Rossendale Valley Tramways and electrifying them would be not less than £140,000."

Rochdale.—In regard to the compulsory taking over of the Bury, Rochdale and Oldham Tramway Co., the bill of costs of the arbitration amounts to £16,201. Rochdale's share of the costs is the largest—£7,068, and the remainder will be paid by seven other authorities through which the company had running powers. The costs have to be paid by the end of September.

Salford.—The tramway men have decided to accept the terms offered by the Tramways Committee, so that the wages of the motormen and guards will remain a ½d. an hour below those of Manchester, but the system of long as against "split" shifts will be retained.

South Lancashire.—The official inspection of the new lengths just completed on the western side of Manchester by the Lancashire United Tramways Co. took place at the beginning of this week—it was originally fixed for last week.

Stirling.—The T.C. has received terms from the new Tramway Co. on which the company is prepared to treat with the Council. The company proposes to construct a double line of tramways through the town, the remainder to be single track construction. The company would prefer to be responsible for the maintenance of the track, but if the Corporation desired it, the company would be willing to pay £50 per mile per annum to the Corporation, the latter to indemnify the company against any claims for accidents. The company agrees to take energy from the Corporation's undertaking at 1½d. per unit, the minimum payment in any year to be £1,200. The Corporation is to have the option of purchasing the undertaking at the expiration of 28, 35, 42, and every seven years thereafter. The Stirling T.C., the Bridge of Allan T.C., and the Stirling C.C. have agreed to act together in this matter.

Swindon.—In regard to our note last week on the working and management of the tramways undertaking, we are informed that for the first 18 months' running (ended March last) the working of the undertaking showed a net profit of £270, after putting by the sum of £940 for depreciation. A profit was also estimated for the year ending March 31st, 1907, but since the recent accident the receipts have suffered considerably compared with the same period last year, and it became necessary to prepare a fresh estimate. The revised estimate shows a small loss after providing for financial charges, &c. The members of the T.C. deem it advisable to pay their way as they go along, and, notwithstanding the heavy addition to the rates to meet compensation claims, the Council has decided to include in the expenditure side of this year's accounts about £1,600 for the following purposes:—(1) Purchase a "tin" extension to the car-shed (estimated to last 20 years); (2) £300 contribution to the rebuilding of a canal bridge; and (3) £970 contribution to the depreciation fund.

It is not usual for a municipality to allocate such items as the above to the revenue account, and under the circumstances, and considering that receipts are likely to be low for the current year, we believe that the Swindon Corporation is certainly doing what most other municipal authorities would not do, and especially so in respect to the depreciation fund, and we are quite in agreement with the Council's decision. It is not anticipated that any call will be made on the depreciation fund for some years hence.

The Finance Committee is not contemplating an inquiry into the business management, as quoted from the *Westminster Gazette* last week, but a special meeting of the Committee is to be held shortly with the object very largely of reviewing the existing fares, Swindon being one of the few towns where halfpenny fares are in vogue.

Walthamstow.—An accident occurred on the 23rd inst., in St. James's Street. Men were engaged in overhauling the overhead wires near the G.E.R. bridge, when the horse attached to the tower wagon, on the top of which the men were standing, moved on; the ladder catching in the wires broke them, and the men were thrown into the roadway, and subsequently removed to the local hospital in a critical condition.

West Ham.—In accordance with a decision arrived at by the Council, legal opinion has been taken upon the question as to whether there is power to invest the reserve fund of the tram-

ways undertaking in the Corporation's own securities. The opinion obtained is to the effect that the Corporation has power to "lend only its sinking fund to itself," and that any sums set aside for reserve funds in respect of either the E.L. undertaking or the tramways undertaking must be invested in securities other than those of the Corporation.

TELEGRAPH and TELEPHONE NOTES.

Austria-Hungary-Italy.—The *Bolletino delle Finanze* (Rome) reports that a communication of the Hungarian Minister of Commerce states that the experiments for regular communication by wireless telegraphy between Ancona and Fiume, directed by the technical council of the Hungarian Director of Posts and Telegraphs, have had good results, and that the line has been opened for regular service.

Chile.—A concession has been granted to the Compania del Telegrafo Comercial of Concepcion for the installation and exploitation of a telegraph line between Concepcion, Valparaiso and Los Andes.

The German Consul at Valparaiso reports that at the end of 1905 there were in Chile 12,579 kilometres of State telegraph line, with 287 stations and 896 officers—501 male and 395 female. Besides this there are a number of private Chilian and English telegraph companies, notably the West Coast Telegraph Co., which is very prosperous. Uninterrupted telegraphic communication between the Magellan district and Northern Chile is, however, sadly needed. It may be stated that experiments have been made on board Chilian men-of-war with wireless telegraphy, and the Marconi Wireless Telegraph Co. has taken out patent rights in Chile for a period of five years. There are in Chile one English and several Chilian telephone companies, of which the Chili Telephone Co. is the most important.

Columbia.—According to the reports from Bogota the telegraph line between Magangue and l'Achi on the banks of the Cauca has just been completed. The towns of Sucre, Palmaril, El Retiro, San Antonio, and Majagual will benefit thereby.

Cuba.—As in previous revolutions, havoc has been played with the telegraph lines throughout the island. The rebels isolated Cienfuegos landwards, and a notice was issued by the office at Berne that telegrams for all towns in Cuba, excepting Havana, Cienfuegos, Casilda, Tunas de Zaza, Jugaro, Santa Cruz del Sur, Monzanillo and Santiago de Cuba were subject to delay. Subsequently, however, the lines between Cienfuegos and Havana became interrupted, delaying telegrams for all places in Cuba and the West Indies beyond, "*viâ* Key West." Communication was subsequently reported as restored.

Glasgow.—It is interesting to note that the P.M.G. has obtained the permission of the Corporation to retain the use of the City arms on the instruments and notepaper used by the Telephone Department, together with the Royal Arms, with a view to marking the origin of the system. Presumably, the Postal authorities wish it to be clearly understood that they were not responsible for the antiquated apparatus originally installed.

Greece.—The United States Consul in Greece reports that there is a growing discontent in Greece over existing telephone conditions. The appliances in use are inadequate, and the service is unsatisfactory. For this reason the telephones are but poorly patronised, and it is stated that they are an unprofitable investment to the Government which controls them. It is probable that the Government would grant a concession to some reliable private company prepared to install up-to-date effective telephones. The people are said to be ready for such a telephone service, and would support it with their patronage. The value of the present plant is about £25,000. The French Ader system is in use, with German switchboards. There are at present only about 600 telephones in operation at Athens, Piræus, Phaleron, Kephissia and Decelia, and one long-distance wire connecting Athens and Patras. The present charges are 100 drachmas (about £4), a year for a local telephone, 250 drachmas (about £10) where connection is made between cities, and 1 drachma (about 10d.) for five minutes' conversation between Patras and Athens. Salaries paid to officers range from 120 to 400 drachmas per month. The Consul considers that there is a profitable opening for American capital, as there appears to be a very general desire on the part of the people for an improved service. For the granting of this, and all similar concessions, a vote of Parliament is needed.

Italy.—According to the *Elettricista*, the Italian Minister of Posts and Telegraphs is contemplating taking over the entire telephonic service of the country, for which object existing private systems will be expropriated. The present owners of these undertakings will be indemnified by annuities paid for the terms of the existing concessions.

National Telephone Directory.—The N.T. Co. has adopted an admirable plan for bringing before the public the names and numbers of new subscribers as they are connected, without waiting for the annual new edition of the Directory or for the supplementary lists. Every Monday a list of the subscribers connected during the preceding week will be published in the *Westminster Gazette*, together with alterations or corrections which may become necessary in the Directory. About 200 new subscribers are connected per week on the average, and on Monday last the first list appeared with about 400 entries.

New Cable.—It is announced that the German-Dutch cable undertaking in the Far East is threatened with competition in the near future. As will be remembered, this joint enterprise was established a few years ago for the purpose of affording a connection between the Caroline Islands of Germany and Kiau-Chau and the American island of Guam on the one hand, and the Dutch Indies on the other. The cables have already been laid and are at work. By this means, the Dutch colonies in the East Indian Archipelago, which, until the completion of the new cables, depended exclusively upon English lines for telegraphic communication with the rest of the world, were afforded a second connection in the shape of the Dutch-German-American cable routes. Now, however, according to the Berlin *Tageblatt*, the Eastern Extension Telegraph Co. has secured a concession from the Dutch Government for the laying of a cable which will connect Java with the Cocos or Keeling Islands in the Bay of Bengal. These islands, which are English property belonging to the Government of Ceylon, form the supporting point of a cable owned by the Eastern Extension Co., which connects Perth on the west coast of Australia with the island of Mauritius, which in turn has cable connections northwards with Zanzibar and southwards with Durban. It will be seen that by means of the proposed new cable between Java and the Cocos Islands, the Dutch Indies will obtain convenient telegraphic facilities with both Australia and Africa, and the Germans expect that the new line will draw traffic from the Sunda Islands and will not be of advantage to the German-Dutch cable enterprise. If the report as to the concession, which is to be for a period of years ending in 1944, should prove correct, it will simply show the foresight of the Dutch Government in manifesting increased confidence in the British lines.

Pacific Cable.—It being reported to the Canadian Secretary of State that the Australian Government had accorded further privileges to the Eastern Extension Co., he made inquiries of the Premier, Mr. Deakin, who replied that no concession had been made or contemplated.

In our leader of last week the date of the *Daily Graphic* article on "A Costly Fad," was incorrectly given. September 14th is the correct date.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 23, 1902	
Cayenne-Pinheiro	Aug. 15, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Garachico (Tenerif)-Santa Cruz	July 12, 1906	
Bolamo-Bissao	July 24, 1906	
Curacao-La Guayra, Curacao-Coro } Closed.	Jan. 11, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Las Palmas-Grand Canary	Sept. 18, 1906	
Arecife-Las Palmas	Sept. 18, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 19, 1906	
Bagdad-Bassorah	July 17, 1906	

Wireless Telegraphy.—Reuter's agent at Ghent reports that the following regulations have been adopted by the Institute of International Law in regard to Wireless Telegraphy:—

1. The air is free. The only rights that States have in it, in peace or war-time, are such as are necessary to their preservation.

2. In the absence of special circumstances, the rules applicable to correspondence by ordinary telegraphy shall be applicable to wireless telegraphy.

3. Each State shall have the faculty, so far as is necessary for its safety, to oppose the passage of Hertzian waves over its territorial waters, whether such waves emanate from State apparatus or from private apparatus placed on land, on a ship, or on a balloon.

4. In the event of correspondence by wireless telegraphy being prohibited, the Government shall at once warn other Governments of the fact.

The regulations are rather in the nature of legal conclusions, and it may be decided fairly that the air must be free, whether within or outside territorial limits. In time of peace wireless bolts will settle themselves, and in the event of war the most cautious country will not send them. It is rather difficult to understand how rules affecting communications under proper control can be applied to wireless telegraphy, and each State will not have any need to destroy Hertzian waves, as it is safe to say that none will exist in time of war. The rule for Governments to warn others when wireless telegraphy is prohibited does not seem practical.

A wireless station is being erected at Prince Rupert, which is the terminus at Kalen Island of the Grand Trunk Pacific Railway, thus connecting it with other coast ports. This system will also connect Prince Rupert with the Pacific cable station at Vancouver Island, an intermediate station being built at Cape Caution. Preparations for the installation are now being made under the direction of officers of the Dominion Government.

Messrs. Sir W. G. Armstrong, Whitworth & Co. have received Government sanction for the establishment of a wireless telegraph station at the Elswick Works, Newcastle-on-Tyne. The system

adopted, says the *Tribune*, will be that of the De Forest Wireless Telegraphy Syndicate, of which company Lord Armstrong is the chairman. The installation will enable the Elswick firm to communicate with vessels which may be on their steaming trials on the measured mile in the North Sea.

Mr. Marconi recently stated that he was pleased with what he saw at Glace Bay. New machinery, he said, was being installed that would add very largely to the transmitting power of the station. It was proposed to erect a mechanical department for the manufacture of machinery necessary for the operation of a wireless station. The difficulty of obtaining the delicate apparatus would thus be avoided. The cost would be about £8,000.

In regard to his new invention, it is a device for ascertaining the situation of a ship at sea in any kind of weather, and Mr. Marconi expects to have it ready within a few months. He thinks it will be of great advantage to the St. Lawrence Gulf and River.

It is stated that satisfactory experiments have been made with the Popoff system between St. Petersburg and Nauen, near Berlin.

CONTRACTS OPEN and CLOSED.

OPEN.

Austria.—October 6th. The Austrian State Railway authorities in Vienna are inviting tenders for an installation of electric lighting in the railway wagon works at Knittelfeld.

Birmingham.—September 29th. The Electric Supply Department invites tenders for the supply of 42,000 tons of coal to the generating stations of the Corporation electric supply department. R. A. Chattock, City Electrical Engineer.

Germany.—The tramway authorities in Cologne are about to invite tenders for the supply of 46 tramcars with full electrical equipment and 40 trailer cars.

Isle of Thanet.—The Electric Tramways and Lighting Co. invite tenders for general stores. See "Official Notices" September 21st.

Johannesburg.—October 15th. Tenders are required by the T.C. for single-phase A.C. motors with accessories. See "Official Notices" August 31st.

Limerick.—October 2nd. Gas plant, gas engine and dynamo, switchboard extensions and cables for the Corporation Electricity Department. See "Official Notices" September 14th.

Metropolitan Railway.—October 8th. The directors want tenders for stores for one year. Some of the items are:—

No. 17.—Electric lamps, carbons, fuses, ebonite, &c.
No. 18.—Electric wires and cables.
Nos. 27 and 28.—India-rubber goods.
No. 42.—Signal iron-work, wire pulleys, switch-boxes, &c.
No. 44.—Telegraph fittings, battery jars, zincs, insulators, &c.

Particulars and forms from the Storekeeper, adjoining Neasden Station, N.W., between October 1st and 6th.

Netherlands.—September 29th. The Municipality of Utrecht invites tenders for the supply of: (1) 12 completely-fitted electric motors for the Utrecht electric tramways; and (2) the supply and erection of an overhead electric tramway system, with all accessories. Tenders to the Municipal Offices, Utrecht. Specifications, &c., may be obtained on payment of 5 francs (about 4s. 2d.).—*Board of Trade Journal.*

Newport (Mon.).—October 13th. Feeder boosters, balancer, electrically-driven pumps, switchboards and instruments, for the Corporation. See "Official Notices" to-day.

Southport.—September 29th. Electric motors, gas engines, pumps, &c., for the Corporation. See "Official Notices" September 14th.

CLOSED.

Aberdeen.—The following is a list of the tenders received (to the specification of Messrs. Owen Lucas & Pyke, consulting engineers) for H.M. Theatre, Aberdeen, on behalf of the Robert Arthur Theatres Co., Ltd.:—

G. E. Taylor & Co.	£5,985	Belshaw & Co.	£4,903
Drake & Gorham, Ltd.	5,390	Buchanan & Curwen	4,874
Warings, Ltd.	5,264	Leo Sunderland & Co.	4,710
Strode & Co.	5,154	Cowtan & Sons, Ltd.	4,239
Roger Dawson, Ltd.	5,144	Aberdeen Electrical Engineering Co., Ltd. (accepted)	3,994
Claud Hamilton, Ltd.	4,965		

Brighton.—The T.C. has accepted the tender of Messrs. Crompton & Co., Ltd., for the supply of 1-H.P. and 3-H.P. electric motors, and that of Messrs. Royce, Ltd., for 5-H.P., 10-H.P. and 20-H.P. motors.

Dundee.—Messrs. Thermit, Ltd., have received an order from the Corporation for the necessary material and appliances for welding 500 joints on its track.

Ipswich.—The T.C. has accepted the tender of the Simplified Underground Conductor Co., Ltd., for underground electric conductors for lighting and power.

Leyton.—The U.D.C. accepted on Tuesday the tender of Messrs. Herbert Morris & Bastert, Ltd., for the supply and erection of an overhead crane for the electricity undertaking.

London.—HACKNEY.—The E.L. Committee report that they have examined the tenders received for the proposed street lighting by means of arc lamps. As a decision upon these tenders had to be subject to the type of lamp to be adopted, whether "flame" or ordinary, the specification was divided into three parts, so as to get alternative tenders (1) applicable to posts and apparatus suitable for ordinary arc lamps; (2) to flame arc lamps, and (3) to switch-pillars which would be required whichever type of lamp was selected. Although the cost of the maintenance of the flame arc lamp was about 18 per cent. more (£13 instead of £11) than that of the ordinary arc lamp, its illuminating power was 100 per cent. greater. There was no doubt that popular opinion was largely in favour of the new light, especially for street lighting purposes, and the erection of the ordinary type of lamp for extensions would probably be regarded as a retrograde step. With the exception of the tenders of Messrs. Santoni & Co., Messrs. Oliver & Co., the General Electric Co., and the Union Electric Co., all the tenders for the flame arc lamps were incomplete, or the firm did not comply with the conditions of the tender. With regard to the tenders for the ordinary type of arc lamps, the Committee did not consider it desirable to submit the engineer's report upon these in view of the feeling in favour of flame arc lamps. The tenders received for the flame arc lamps were as follows:—

Improved Elec. Supplies	£1,183	British Elec. Equipment Co.	£1,579
The Electrical Co.	1,307	Union Electric Co.	1,604
Crompton & Co.	1,400	Santoni & Co.	1,671
British Thomson-Houston Co.	1,451	Brockie-Pell Arc Lamp Co.	1,754
Armorduct Manufacturing Co.	1,500	Oliver & Co.	1,767
Johnson & Phillips	1,531	General Electric Co. (recommended)	1,808
R. W. Blackwell & Co.	1,557		

Exhaustive tests had been made by the borough electrical engineer of sample lamps submitted by all the best known makers, and the Committee had inspected the lamps in use in Graham Road and Evering Road. The Angold lamp, tendered for by the General Electric Co., had given the best all-round results, taking into consideration not only the burning of the lamp but also the cost of carbons. The higher price of the company's tender was due to the cost of their better type of contact gear. As an alternative tender they offer a cheaper type of gear, which would reduce the amount of their tender to £1,585, and leave it strictly comparable with the tenders of the other makers. The Committee were advised by the engineers that the higher class gear only should be used, and they accordingly recommended that the tender of the General Electric Co. for Angold flame arc lamps, at £1,808, be accepted. The following tenders for pillars were received:—

W. Lucy & Co. (recommended)	£1,174	General Electric Co.	£1,543
Brush Electrical Eng. Co.	1,214	Improved Elec. Supplies	1,548
R. W. Blackwell & Co.	1,218	Mackenzie & Moncur	1,572
John Spencer	1,261	W. MacFarlane & Co.	1,575
Rowland Carr & Co.	1,367	Armorduct Manufacturing Co.	1,599
Jas. Allen, Senr., & Son	1,402	Falkirk Iron Co.	1,605
British Elec. Equipment Co.	1,456	J. & A. Law	1,811
Johnson & Phillips	1,477	S. Pontifex & Co.	1,916
W. T. Allen & Co.	£2,010		

The following tenders were received for the erection of pillars:—

British Elec. Equipment Co.	£362	R. W. Blackwell & Co.	£496
British Elec. Engineering Co.	376	British Insulated and Helsby Cables	536
General Electric Co.	443	Johnson & Phillips	547
W. Lucy & Co. (recommended)	479	W. T. Allen & Co.	582
Improved Elec. Supplies	485		

The Committee reported that there were good reasons in this case for combining the erection with the supply of the pillars into one contract in order to secure undivided responsibility. The lowest tender for pillars and erection complete was that of Messrs. Lucy and Co., Ltd., amounting to £1,653, while the sum of the lowest tenders for each individual section was £1,536, made up as follows:—Pillars, Lucy & Co., Ltd., £1,174; erection of pillars, British Electric Equipment Co., £362. The difference was £117, and under the circumstances they considered it would be wise to pay this sum to get the work done by the makers of the pillars. The following tenders were received for switch pillars:—

R. W. Blackwell & Co.	£130	British Insulated and Helsby Cables	£210
British Elec. Equipment Co.	141	Armorduct Manufacturing Co.	220
Cable Accessories Co. (recommended)	163	J. E. Spagnoletti & Co.	221
Johnson & Phillips	170	General Electric Co.	237
Improved Elec. Supplies	172	Callender's Cable & Cons. Co.	308

FULHAM.—In accordance with the report of the borough electrical engineer on tests he had made with the new "stokers," the tender of Messrs. Gillman & Co. for the supply and delivery, during the period ending June 30th next of 1,500 tons of "Nutty Slack" from the West Hallam pits, at 9s. 11d. per ton, has been accepted by the Council. The tender of Messrs. A. W. Davies and Co. for wiring the new boiler house at the electricity works, for the sum of £385, has also been accepted.

BATTERSEA.—The B.C. has accepted the tender of the Tudor Accumulator Co., Ltd., at £195 per annum, for a period of 15 years for renewing the cells and maintaining the efficient working of the battery at the central electricity station.

St. Pancras.—In connection with the list of tenders published in our last issue, for steam turbine plant, we are asked to state that Messrs. Willans & Robinson's tender of £8,857 was not strictly comparable with the others given; it excluded certain items offered as extras; these were included in the published prices of the other tenders. We understand that, after allowing for the extras and taking into consideration the quick delivery promised for the plant, the tender of Messrs. Willans & Robinson was still considered the most favourable.

Southampton.—The T.C. has accepted the tender of Raworth's Traction Patents, Ltd., for regenerative control equipments, at £100, and motors at £73 each.

Sydney, N.S.W.—The *Australian Mining Standard* says that owing to the great demand at present existing in Sydney for electricity, the Electric Lighting Committee of the City Council has decided to recommend that the resolution providing for the calling of tenders in connection with the proposed extensions be rescinded, and that the contracts entered into with the Stirling Boiler Co. and others be duplicated, which course would allow of the work being carried out more expeditiously.

Walsall.—The T.C. has accepted the following tenders:

Bunch & Sons and Mantle & Co.—Ironwork for tramcar covers.
Rawlinson & Son, Blackburn.—Tower wagon.
Jones & Evans.—Boiler flue at generating station.
Mr. C. Ross.—Electric bells at the Higher Education Schools.

West Ham.—The Corporation has ordered seven additional tramway cars under its contract with the British Westinghouse Co., and has also accepted the following tenders for coal-handling plant, &c., for the electricity undertaking:—

J. Fraser, 4-ton hopper	£49	0
Thames Ironworks and Shipbuilding Co., special Hone grab, 20 cwt. capacity (less 2½ per cent.)	155	0
Chatteris Engineering Co., 5-ton crane	875	0
Dick, Kerr & Co., turntable	70	0
Ferranti, Ltd., six panels for sub-station equipment, each	39	15

FORTHCOMING EVENTS.

Friday, October 5th.—At 8 p.m. Electro-Harmonic Society. First smoking concert of the season at Holborn Restaurant.
Open to October 17th.—Engineering and Machinery Exhibition at Olympia, Kensington, W.

NOTES.

Self-Exciting Self-Regulating Three-Phase Alternators.—With reference to the note appearing under this head in our issue of August 3rd, p. 172, we are informed by the makers, Messrs. Felten & Guilleaume-Lahmeyerwerke Actien-Gesellschaft, of Frankfurt-Main, that the Heyland generators of this type are made from 15 H.P. *upwards*, not up to 15 H.P.

Electrical Production of Steel.—The claims put forward in interested German circles on behalf of the Héroult process for the electrical production of steel, to which reference was made in our issue of September 14th, have evoked replies also from Teutonic quarters in defence of the ordinary crucible steel method, and in opposition to the advantages attributed to the French system, as practised at Remscheid. In the latter case it is submitted that the Kjellin process at Volklingen has yielded good results throughout, and that the advocates of the Héroult principle are not without an object if they award to it a greater measure of purification of inferior raw materials, &c., than to the Kjellin system. The crucible interests, on their part, point out that electrical steel has hitherto only been produced by those countries which have abundant water power, and consequently cheap working facilities, at their disposal. Thus, in Sweden steel has been made for some time past in this manner, whereas it is only now that Germany has taken up the matter. The industry is, however, only in its initial stage, and no actual results are yet available. As to the assertion that electrical steel is superior to crucible steel, it is urged that as produced down to the present time the former has actually been of an unequal quality, which is not surprising, in view of the novelty of the process, and the lack of experience. The smelting of steel in the electric furnace, unless electrical energy is obtained cheaply by means of water power, is dearer than that incidental to the use of Siemens regenerative furnaces. If, then, steel is to be made in electric furnaces where cheap water power is lacking, the reason is to be sought in the object of producing from cheap raw materials steel which it has hitherto only been possible to obtain by the expensive crucible process. The lower costs of the electrical method in comparison with the crucible process are obtained by the introduction in the electric furnace as raw materials of cheap scrap iron and pig-iron, or of iron smelted by the Thomas (basic) and Martin systems. It is, however, in the opinion of the crucible interests, wholly erroneous to assume that the electrical method is able to transform such inferior materials into a high-class steel. It is admitted that by the use of these materials a far-reaching purification from injurious contents, such as phosphorus and sulphur, is obtained, and that the resulting steel is to be regarded of higher quality than ordinary Bessemer and open-hearth steel, but the quality of crucible steel is by no means attained by the elimination of phosphorus and sulphur. Indeed, the question arises, for instance, as to the behaviour in the electric steel of the copper and arsenic derived from the scrap iron. In statements as to the analysis of electric steel the makers are silent on this matter, and, in point of fact, because the content of these constituents exceeds the extent of that permissible for high-grade crucible steel. It is known to every expert that a high copper content such as constantly exists in scrap iron materially prejudices the quality, and the same observation applies to arsenic. A further difference is that at the end of the smelting operation crucible steel is ready, and possesses a definite composition. On the other hand, electric steel, which is subjected to a purification process, requires, as in the case of open-hearth and Bessemer qualities, fluxes at the end of the smelting and deoxydising fluxes, such as aluminium and silicon. These fluxes give rise, on the one hand, to unequal quality; and, on the other, the deoxidising fluxes frequently leave behind in the steel residues which increase the mechanical pollution of the metal. In these circumstances the crucible advocates contend that electric steel produced in this way will not oust the former at the present time, although the electric furnace may in course of time yield a product of equal quality, provided that the same raw materials are employed as are used in the manufacture of crucible steel. The Héroult interests have lost no time in giving an answer, stating that the observations set forth are correct in regard to the Kjellin method, but not in the case of the Héroult process. They declare that in all other methods an addition is made at the end of the smelting operation of deoxidising materials, such as ferro-manganese and ferro-silicon, of which a portion is oxidised and passes into the slag. But in the Héroult process, manganese ore is added during the operation, and the metal is found in the steel to the last one-tenth of 1 per cent.; and ferro-silicon is only added in such quantities as are necessary for obtaining the desired analysis. Finally, the slag resulting from the process is stated to be so completely free from oxide as to be entirely white. The method, in contradistinction to all others known, is said to be so reducing that any "slagging" of the constituents of the iron is avoided, and no deoxidising means has to be added, and consequently no kind of slag can be formed in the steel. It is suggested, in conclusion, that the holders of the Héroult patents would probably permit the accuracy of these statements to be personally substantiated at the Remscheid works, where it would be found, it is added, that the prejudices against the process are by no means justified, especially in the case of the assertion that the quality of the steel produced is irregular.

Firemen and Live Conductors.—The possibility of firemen receiving dangerous shocks from live cables during fires has engaged the attention of electrical experts in various countries, but hitherto unanimity on the subject of precautionary measures has not been reached. A recent discussion by the German Electrotechnical Society of experiments previously carried out proved abortive, as division of opinion was still manifested. According to Herr Kuhlmann, it is impossible to direct a jet of water on a cable working at a pressure of 3,000 volts without receiving a serious shock. On the other hand, Herr Görges contends, as the result of experiments made 10 years ago in Upper Silesia, that a 10,000-volt cable may be safely played upon if the fireman stands a metre off and wears rubber gloves. To this Herr Kuhlmann retorts that neither rubber gloves nor boots are a protection, as they can be easily split, and according to him, the best protection is afforded by connecting the metallic part of the hose by means of a 6-mm. diameter wire with a good earth (a lightning conductor earth, for example), or, failing this, a large metal plate, placed on the wet ground, on which the fireman stands.—*La Revue Electrique.*

Electricity in German Government Coal Mines.—At the present time a large scheme of extension is in progress in connection with the State coal mines in the district of Saarbrucken, and a complete transformation in the methods of working the pits will be brought about in a few years by the substitution of electrical working on a comprehensive scale for the usual steam system. With this object in view, the Saar State Mining Directors are having laid throughout the whole district an extensive network of cables which will be able to supply any particular point, and the numerous independent installations already in existence, which represent about 10,000 H.P., will also be brought within the scope of the scheme of development. It is proposed by the State mining authorities also to afford a supply in bulk to the communes, and to industrial undertakings in the district, and to provide power for the working of tramways.

Electro-pneumatic Brakes.—In electric railway service the frequency of slow-downs and stops is so much greater than in steam railroad practice, that the admirable equipment of the latter system is inadequate to supply the repeated applications of the former, and in long trains there occurs a time interval due to the serial action of the brakes on the different cars which often results in discomfort to standing passengers. The possibility of making rapidly repeated applications has been well provided for in the latest pneumatic brake systems for electric railway service; the electro-pneumatic system goes a step further than this, however, and provides an instantaneous brake action throughout the train, no matter how many cars there may be in it. This instantaneous

action also provides stops and slow-downs of greater smoothness than previous experience has realised.

An electro-pneumatic system invented by Mr. W. S. Bartholomew consists essentially of an electric contact apparatus fitted to each brake valve, electric application and release magnets controlling the supply and exhaust of air to and from the brake cylinders on each car, and a train line of two wires with suitable plugs and sockets for reproducing the application and release magnet movements throughout the train. The current supply for the magnets is drawn either from the third rail, trolley, or a small storage battery carried on the train, and it is of sufficiently low voltage to be harmless. This system, which is the latest product of the Westinghouse Air Brake Co.'s engineers, may be applied to any one of the later air-brake equipments. It is used almost entirely in making service applications of the brakes, emergency applications being made by the purely pneumatic side of the equipment. The addition of the electric applications and release apparatus practically equips each car with "straight air"—that is, the auxiliary reservoir pressure is applied to the brake cylinder and discharged from it without the operation of the triple valve or any indirect reduction of pressure. Applications may be made as often as desired without danger of depleting the pressure of the air supply sufficiently to render the action of the brakes uncertain; and the release of the brakes may be graduated with any degree of accuracy required.

Comparative Cost of Steam Engines, Steam Turbines and Gas Engines.—We have received the following communication on this subject:—

"At a first reading of the interesting set of tables which you reprinted (September 7th) from the *Electrotechnische Zeitschrift* on the above subject, it struck me that the capital cost given under gas engines for the case examined was excessive. I, therefore, went to the trouble of comparing the figures, with a view to ascertaining in what manner the German mind had worked out the problem so as to leave gas engines in the position of a good second to turbines.

"I found in the first place (and the item was at once illuminating) that the German writer was thinking in horizontal gas engines, whereas we over here now make, for this class of work, very extended use of vertical engines. This at once brought his charges for engine room (£1,750) and generator foundations (£1,100) to £1,225 and £725 respectively, reducing the cost on those items alone by £900; in other words, leaving the figures for those items the same for both reciprocating and gas engines—an approximately accurate parallel.

"The next big reduction was in 'spare parts.' Why the cost of spare parts of the gas engine should be given as equal to the cost of those for both reciprocating engine and turbine combined is something that perhaps one of your readers may be able to explain. I cannot. Indeed, I cannot see a reason for putting this sum (£450) any higher than for the turbine, namely, £150, thus further reducing the total by £300.

"Again, surely, if less fuel is required—as it clearly is—for gas engines than for reciprocating engines, and the cost of trucks, rails, weighing machines, &c., must therefore be considerably less, it is a rather cool proceeding to place this item for the former £250 in excess of that for the latter! Let me, in a feeble sort of way, try to imitate this German equanimity by placing it at the same figure, reducing the bill for these by £250.

"Lastly, why the cost of 'coverings for pipe troughs' should differ by £140; why the travelling crane should cost £55 more; and why switchboard and cables should run to £65 more in the gas engine than in the reciprocatiag engine plant, I should be very glad to understand. I have no hesitation in putting the figures down alike in each case, thus further reducing the total by £230—total reduction, £1,680.

"Your readers will recall that the German writer's figure totals were: Turbines, £18,300; gas engines, £19,860; reciprocating engines, £23,730. They now stand: Gas engines, £18,180; turbines, £18,300; reciprocating engines, £23,730.

"If any of said readers are spoiling for a 'scrap,' I am (with card enclosed), Theirs and Yours obediently, VERTICAL ENGINE."

To this we may add that, if the comparison is to be converted to British practice, the vertical reciprocating steam engines ought to be made to run at a speed not less than 300 R.P.M. instead of 140 R.P.M.; this in turn will cheapen the steam engine plant, foundations and buildings, and, perhaps, further amendments will follow. But where is a vertical gas engine of 700 I.H.P. to be seen running?

Electro-Harmonic Society.—The first smoking concert of the season will be held at the Holborn Restaurant (King's Hall) on Friday, October 5th next, commencing at 8 o'clock. The programme includes vocal music by Mr. Harold Wilde, Mr. Bertram Mills and the Westminster Glee Singers; instrumental music will be rendered by Mr. Alfred E. Izard and Mr. Harvey Tipper; while Mr. Edward Minshall, Mr. Fred Rome and Mr. Nelson Jackson will be responsible for the humorous items. The music will be under the direction of Mr. Alfred E. Izard and Mr. T. E. Gatehouse.

A Steel-Tube Combination.—The deadly competition which has made tubes a by-word on the markets has ceased, and from henceforth until internal strife rends the combination asunder, most engineering work will be more expensive. For the time being water-tube boilers will not be increased in price, so we can confidently recommend engineers to lay in heavy stocks of these useful articles. The reason for this exception is that one large Glasgow firm remains a blackleg, and is to be peacefully picketed, or, in the regrettable language of the *Times* (September 15th), is to be "gone for." That process may be painful for the Glasgow firm, as it savours of severe cutting; but, for the same reason, it will afford considerable satisfaction to the surrounding crowd of blood-thirsty buyers. The *Times* says that this is one of the most important commercial agreements ever made in this country, for the gross annual output of the trade is 300,000 tons, of a value of nearly £6,000,000, at the average price of £20 per ton. It meets with the support of the leading American producers.

Appointments Vacant.—A head of the Physics and Electrical Engineering Department is wanted for the Victoria Jubilee Technical Institute at Bombay (R.600 per month) on a five years' engagement; jointer (36s.) and two junior switchboard attendants (25s), for the Wishaw electricity works; a superintendent of telephones and foreman of electric light service is required for Dominica, West Indies (£240); switchboard attendants for Portsmouth Corporation (25s.); assistant electrical engineer for Stretford U.D.C. (£120); shift engineer for Peterborough (30s.).

Electric Shock Fatalities.—An inquest was held at Enfield Highway relative to the death of Wm. James Winepress, who met with his death as the result of an electric shock sustained at the North Metropolitan Electric Power Co.'s generating station at Brimsdown, Enfield Highway, where he was employed. Mr. Ram attended on behalf of the Home Office, Mr. Smee represented the company, and Mr. J. Avery appeared for the widow. The evidence showed that deceased was employed to do small mechanical work. Whilst mechanics were engaged in putting plugs in the wall of the cable trench—which is under the high-tension room and the engine room—deceased asked for the loan of a quarter-size stock and die for making a thread in a piece of copper tubing which he held in his hand. As he was told that he would find it in a tool box, deceased made a half turn, and was in the act of making his way out in the same direction as he entered, when there was a report and a flash. The workmen did not know what had happened, but they as quickly as possible made for an opening. The engineer in charge was informed, and the engines were stopped. Some of the men went through the high-tension tunnel, and saw the deceased lying across a joint box; the piece of tubing was lying 2 or 3 ft. away from his hand. Deceased had no business in the trench, as notices were placed about warning employés against entering it. Winepress was dead, having probably received a shock at 10,000 volts. One of the coils overhead had got alight, and pitch was dropping on to the deceased's arm. The fire was extinguished by means of sand. A witness gave it as his opinion that the deceased stumbled and fell across the high-pressure terminal so that one hand pressed heavily, or it might be that the insulating tape was pierced by what he held in his hand. The jury held that deceased went to a place where he had no business to go, and a verdict of "Misadventure" was returned.

The inquest was opened on 21st inst. on Thomas William Allsopp, a young man employed at a Derby pork butcher's, who was killed on Thursday last week through coming into contact with a "live" electric wire. The proceedings were resumed on Wednesday.

Fatality.—On Tuesday an inquest was held concerning the death of a painter named Bodenham, who died on Saturday after meeting with an accident three weeks previously at the Hart's Hill depôt of the Dudley and Stourbridge electric tramways. Ernest Withy, 19, tram conductor, said that on the morning named he and motorman David Massey, were about to take charge of a car which was in the sheds when witness went to the controller at the front and moved the handle. At the time the motorman was inside the car. Witness had no idea that the current was on, and was surprised to find the car move and collide with another car which was standing a few inches distant on the same line. Witness applied the brake immediately and stopped the car. He heard shouting, and found that Bodenham, who, without witness's knowledge, had been engaged painting at the bow of a third car, was injured. Witness admitted that as a conductor he had no right to interfere with any working part of a car without first obtaining permission, and this he had not done. David Massey, the motorman, could give no information as to who put the handle on the controller, and he could not state who switched the current on. The jury returned a verdict of "Accidental death," adding that there was negligence on the part of the company's servants.

Electrolytic Disinfectant.—Referring to the extraordinary disinfecting and deodorising power of electrolysed salt water, in connection with the plant installed at Poplar, the *Lancet* says:—"There can be little doubt that it is of the utmost importance that the electrolysed saline fluid should be permanent as regards its strength, as represented in terms of available chlorine. Many improvements in a practical direction have been made, so that not only is an active antiseptic fluid turned out continuously and needing little attention, but one which keeps at a standard strength and is permanent. The solution used contains magnesium chloride and sodium chloride. Magnesium chloride used alone does not give satisfactory results, while it more readily furnishes active chlorine compounds than the sodium salt. The solution is made faintly alkaline with caustic soda so as to prevent the formation and escape of free chlorine in the cells. The electric current is governed automatically in order to give constant results and to avoid overheating. The stability of the newly electrolysed fluid is secured by the addition of a proper quantity of caustic soda. At the Poplar installation a paddle with rubber flaps is rotated in the fluid at the moment when it leaves the electrolysers, and it is intimately mixed with some caustic soda solution. The resulting

solution shows no loss of strength. It is probable that this procedure results in the formation of a double hypochlorite of magnesium and sodium which, unlike the corresponding salt of magnesium, is quite stable. The process is extremely simple and the plant requires only a minimum of attention, the output of the disinfecting fluid, constant in strength, being perfectly regular and continuous. Mr. F. W. Alexander, the medical officer of health of the borough of Poplar, has devoted considerable energy and time to reducing the installation to a thoroughly practical concern, with the satisfactory result that the plant works with complete smoothness. It is capable of turning out an almost unlimited volume of efficient disinfectant by merely supplying a saline fluid and switching on the current. In time of epidemic such an installation should be invaluable."

Tramcar Accident.—An inquest was held at Sunniside, Houghton-le-Spring, on the 22nd inst., into the circumstances of the death of a man named Michael Paton, who was crushed by a tramcar, which left the rails at that place on the 19th inst. From the evidence it appeared that as the car was coming down the hill near Graswell, where there is a curve, it left the line, and crushed the man against the wall of a house. William Adams said that he was the driver of the car that crushed Paton. He was proceeding in the direction of Newbottle. At the top of the bank just on the outskirts of Houghton, he made the compulsory stop provided by the regulations of the Board of Trade. From that place to where the car left the line, he thought the distance would be about 200 yards. He did not know the length, nor the gradient of the bank. At the top of the bank he applied the magnetic brake. The car had gone about six yards when he found the brake had failed to act; he threw sand out and applied the hand brake, but he could not pull the car up, and it left the metals after having gone about 20 yards. He had never known the brake to fail before. Before he applied the brake the car was not going at more than three or four miles an hour. He did not think the bank too steep for the safe working of the cars. He did not put on the brake too strongly. He never had had any difficulty in negotiating this curve before. A letter was put in from one of the passengers on the car at the time to the effect that he was sure that the driver did all that he could to avoid the accident. Henry T. Watkins, resident engineer to the Sunderland and District Tramways Co., Ltd., said that taking all the circumstances into consideration, it was probable that the failure of the magnetic brake was the cause of the car going off the line. On the previous occasions to which reference was made when the car went off the line, it was due to the flange of the wheels breaking. At that time they used cast-iron wheels. Although they were very largely used, the company found that they were very unsatisfactory for this district, owing to the fact that they got chipped, and in consequence they had commenced to use steel tires, which would not chip. These had been fitted on all the cars. The wheels of the car which ran off on the 19th inst. were quite sound. There was nothing the matter with the curve, it had been checked and gauged since the accident, and was found to be in good order. Mr. Heath, on behalf of the company, expressed their regret at what had happened. A verdict of "Accidental death" was returned, and the driver was exonerated from all blame.

Oxford Tramways: The Dolter System Adopted.—It is reported that on Wednesday the question of the electrification of the Oxford tramways was settled by the City Council's acceptance of the National Electric Construction Co.'s tender to lay down the Dolter system.

Junior Institution of Engineers. — A party of members of this Institution, approaching 100 in number, availed themselves of the invitation given by the Associated Portland Cement Manufacturers (1900), Ltd., to visit their Northfleet works on Saturday afternoon, September 22nd. All the processes in the manufacture of Portland cement by the most modern methods were seen in operation, including the amalgamation of the raw materials, chalk and clay, the slurry mixing, the treatment in the rotary kiln, in the cooling cylinders and the pulverising cylinders, the final product coming out in the form of fine powder. Electrical power is largely employed at the works, and considerable extensions are being made.

Canal Lighting.—It is reported that the maritime canal, 1,000 miles in length, between the Baltic and the Black Sea, the construction of which is about to commence, will be lighted by electricity.

Moore Vacuum Tubes.—A correspondent asks whether these are supplied in this country, and if so, by whom?

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—Mr. W. HORSFALL, of Llangollen, has been selected for the appointment of resident engineer at the Ebbw Vale electric light works.

The Hebden Bridge U.D.C. Electricity Committee, on September 20th, selected Mr. W. HARWOOD as assistant engineer at the electricity works out of 30 applicants.

Upon leaving Lymington, where he had been in the service of the local electric lighting company for the past six years, to take up a position at High Wycombe, Mr. FRANK COOPER was presented with a sovereign purse.

Southampton Electricity Committee has recommended the T.C. to make the following appointments:—Mr. H. L. MILLS, chief assistant electrical engineer, £210 per annum, rising by £10 a year to a maximum of £250; Mr. J. B. B. HOWAT, second assistant and station superintendent, at £170 per annum, rising by £10 a year to a maximum of £200.

The Falkirk T.C. has increased the salary of Mr. J. MCMILLAN, the resident electrical engineer, by £20 per annum.

Mr. J. A. MCMULLEN has resigned his position as station engineer of the large gas-driven electric generating plant of the Johannesburg Municipality, and will be returning to England about the end of October.

General.—Mr. J. MILNER, of the staff of Messrs. Dick, Kerr & Co., at Swadlincote, who is leaving for South Brazil in the firm's interest, has been presented with a dressing case by the staff and friends.

Mr. W. STEPNEY RAWSON, M.A., M.I.E.E., consulting electrical engineer, announces that, after September 29th, his business address will be 23, Fitzroy Square, London, W. (near Tottenham Court Road).

Messrs. Stevenson & M'Guffie, consulting, mechanical and electrical engineers, of 87, Union Street, Glasgow, announce that, owing to the death of Mr. George Stevenson, they have assumed Mr. ALEX. MILNE as a partner. The business will be carried on under the name of Stevenson, M'Guffie & Milne, at the same addr. ss.

Mr. HERBERT LAWS WEBB has just returned from his annual telephone inspection trip on the Continent, having visited Denmark, Germany, Bavaria, Austria, Switzerland and France. In Copenhagen the telephone system is being converted to common battery working. Both in Germany and in Austria experiments are being made with automatic exchanges, but so far no automatic exchanges of any size have been equipped. In the meantime the conversion of the Berlin system to common battery working is proceeding, and two large exchanges are now equipped with the new plant. It is the intention of the French Administration to adopt common battery working in Paris.

Obituary.—The *Times* records the death on September 14th of Mr. DAVID HENRY GOODSALL, who was for many years a director of the Western Telegraph Co.

CITY NOTES.

Willans & Robinson, Ltd.

THE twenty-fifth half-yearly report of the directors, to be submitted at the meeting to be held at Cannon Street Hotel, on Wednesday next, says that the accounts for the period show a profit of £4,085 for Rugby, and a loss of £10,620 at Queen's Ferry, or a loss of £6,535 in all for the half-year (against £13,075 in the preceding half-year).

"The above correctly states the results of the trading operations of the half-year by itself, after providing for depreciation. But it must be pointed out that serious losses will have to be faced, arising out of transactions of earlier date, not connected with Queen's Ferry, which must eventually lead to a considerable writing down of some of the assets. As regards the Queen's Ferry items, this is already understood by the shareholders, who will realise that it would be premature to attempt to assess the loss until the Queen's Ferry works are actually disposed of. As regards the other items in question, some are in part ascertainable at present, while others can only be estimated. Without going into details, it may be said that the financial position of certain of the electric power companies, recently disclosed, makes it inevitable that there will be a heavy loss under the head of "Debtors," and for the same reason "Shares and Debenture Stock in other Companies" require to be largely written down. A considerable amount has been expended upon patents and experiments, and development work generally, in connection with large gas engines, including considerable losses resulting from the first orders taken. In view, however, of the successful development of the steam turbine business, it is improbable that it will be worth while to make gas engine building a permanent part of the company's business, and under these circumstances the whole expenditure ought to be written off. Recent improvements in the Willans engine have affected the value of many of the spare parts of older pattern kept in stock, and although the value of these spare parts has been heavily written down in recent half-years, yet it is desirable to write off a considerable further sum. From the foregoing causes (which are independent of Queen's Ferry) it is estimated that an amount of £92,875 4s. 11d. may ultimately require to be written off. It is desirable that this should be dealt with at the same time as

the Queen's Ferry loss, rather than by writing off by instalments as exact figures are obtained. A suspense account has therefore been opened, to the amount stated, which is balanced by corresponding amounts written off under various credit items of the balance-sheet."

The United Electric Car Co., Ltd.

Mr. R. H. Prestwich, of Manchester, presided at the annual meeting of the above company, which was held on Thursday last week at Preston. The Chairman of the company, Mr. George Richardson, was unable to attend through indisposition. The directors, Mr. Prestwich said, regretted having to recommend a reduced dividend. The Hadley and Trafford Park Works were purchased in the hope that, by their removal from the field of competition, their own business would benefit. Their anticipation of larger profits, however, had not been realised. In the orders placed with the company and the number of cars they had produced and delivered, they had had a busy year. The purchases referred to had been, in the directors' view, a thoroughly sound and business-like proceeding; but in all businesses incidents occurred, now and again, which must remain undisclosed. Sometimes they affected the personal ability and character of individuals; at other times they had reference to transactions with municipal corporations whom it was essential to conciliate and please. The directors were able to trace distinctly a very large loss on one important contract to a mistake which, in their judgment, might have been avoided. Had this contract not been undertaken, their dividend would have been appreciably more satisfactory than it was. There was no desire on the directors' part to shirk responsibility in matters relating to the conduct of the business, but it was only fair to state that certain particulars which led up to the unfortunate transaction referred to were withheld from them until it was too late. The experience of the year's trading, whilst disappointing, had been useful to the board in many ways; they now saw where mistakes in relation to control and management could be avoided. The statement he had made was far from cheering, but he had endeavoured to acquaint the shareholders mainly with the actual position without going into details, which were best omitted. In what had occurred there was nothing which affected the future prosperity of the concern. They had still plenty of orders on hand, and the works were assured of employment at full strength for some months. He moved the adoption of the report.

The motion having been seconded by Mr. J. Kerr, the report was adopted, and a dividend at the rate of 5 per cent., less income-tax, on the ordinary shares was declared. It was also decided to write off £1,645 from the preliminary expenses in connection with the purchase of the Hadley and Trafford Park works, and to carry forward £2,135.

Replying to questions, the Chairman said the extensions at the Preston works had enabled the company to execute all orders, and it had not been found necessary to continue the Trafford Park works, which were at present idle.

British Thomson-Houston Co., Ltd.

The report for the year ended March 31st last, to which we made a brief reference last week, states that the buildings and machinery at Rugby have been maintained in first-class condition during the year, and the directors have followed their usual practice in providing for depreciation thereof. They have also provided for depreciation of patents and stock in hand, besides making reserves sufficient, in their opinion, to cover risks in connection with bad debts, depreciation of shares held by the company and for other contingencies. The number of hands employed, excluding the office staff, at March 31st was 1,877, and has since increased. Up to date the company has sold in the United Kingdom heavy traction railway motors having a capacity of over 250,000 H.P. During the period under review the company has acquired from the A.E.G. the British patents covering the Winter-Eichberg system for single-phase railway work, and with the consent of the company the A.E.G. has entered into a contract for single-phase equipments with the L.B. and S.C. Railway Co., which will be the first railway in Great Britain equipped with single-phase plant. The company also owns for the United Kingdom the Latour patents and the patents covering the single-phase system developed by the General Electric Co, of New York. During the period under review the company has acquired from the General Electric Co., of New York, and the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston all their British patents on very satisfactory terms, and prior to March 31st, 1905, it made a similar contract with the A.E.G. During the year the company has entered into a number of contracts for high tension switchgear, Curtis steam turbines and other apparatus and supplies. The company has sold to date Curtis turbines having a total capacity of 32,000 KW. The directors believe that the company has good value in the enterprises in which it has investments. It was mentioned in last year's report that after the closing of the books, March 31st, 1905, the company had disposed of a large amount of securities and reduced proportionately its liabilities. The securities sold realised £372,631, and the entire proceeds were used to reduce to that extent the company's indebtedness. The trading profit for the year, after deducting general and technical expenses, discounts, debenture and other interest, amounts to £31,549. The amount brought forward from March 31st, 1905, is £1,696, making a total available profit of £33,245. The whole of this profit (with the exception of £4,124 carried forward) has been applied to various depreciations, which the directors believe to be ample. As shown on the balance-sheet last year, the balance of the excess cost of manufacturing, incident to the establishment of the manufacturing business of the company, amounted to £39,261 (£28,000 having been previously written off). The amount added during the year was £446, making a total in this account of £39,707. From this there is written off the further sum of £8,000, leaving a balance of £31,707, from which further amounts will be written off from time to time until finally disposed of. The directors record with great regret the loss by death of one of their colleagues, Mr. S. Kocherthaler, and also of their works manager, Mr. Charles W. Phipps.

The eleventh ordinary general meeting of this company was held on Wednesday at the offices, 83, Cannon Street, Mr. J. F. Nauheim presiding.

The Chairman briefly moved the adoption of the report, and said that there were few remarks for him to make. Their report for the year was much more satisfactory than their preceding one. The settled state of the electrical industry, which it was supposed had set in, had so far not affected them, but he hoped that next year they would be able to show better results. Their report was satisfactory owing to one or two things, chiefly their reduction in indebtedness. They had also disposed of a large amount of their investments. They owed last year to sundry creditors £676,000, and this they had reduced to £339,000. The £40,000 debt to their bankers they had brought down to £25,000. He considered that their balance-sheet for March, 1906, showed a much more liquid state of affairs than any preceding one.

Mr. Franklin seconded the motion, and the report was adopted without discussion.

Eastern Extension Telegraph Co.—An interim dividend of 2s. 6d. per share for the quarter ended June 30th has been declared.

Calcutta Tramways Co., Ltd.—The directors have declared an interim dividend of 3s. 6d. each on the ordinary (old) shares (at the rate of 7 per cent. per annum) for the half-year ended at June. Last year's interim dividend was at the same rate.

Dundee, Broughty Ferry and District Tramways Co., Ltd.—The report for the period from April 4th, 1905, to July 31st, 1906, states that the profit amounts to £2,565, and it is proposed to extinguish the preliminary expenses by a payment of £226, to pay a dividend on the preference shares for the period from January 1st to July 31st, absorbing £1,750, and to carry forward £588. The profits are derived from seven months' operation of the system.

Anglo-Argentine Tramways Co., Ltd.—The directors have declared an interim dividend to June 30th last of 4s. per share on the ordinary shares Nos. 260,008 to 430,007 inclusive, being at the rate of 8 per cent. per annum, free of income-tax, payable on and after October 8th next. The transfer registers will be closed from September 25th to October 6th.

Utah Light and Railway Company of Salt Lake City, U.S.A.—Summary of earnings and expenses for the four months ended July 31st, 1906:—

	1906.	1905.
Gross income	$506,983	$432,035
Less operating, general and maintenance expenses	324,254	276,678
Net from operating	$182,729	$155,357

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—

Wednesday, October 3rd.—United River Plate Telephone Co., Ltd.—Further issue of 20,000 ordinary shares of £5 each, fully and £2 10s. paid, Nos. 80,001 to 100,000.

And ordered the undermentioned securities to be quoted in the Official List:—

County of London Electric Supply Co., Ltd.—Further issue of 10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 70,001 to 80,000.

Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Further issue of 12,500 ordinary shares of £5 each (issued at £2 per share premium), £2 16s. paid (£2 capital and 16s. premium), Nos. 75,001 to 87,500; and 12,500 preference shares of £5 each (issued at 10s. per share premium), £2 4s. paid (£2 capital and 4s. premium), Nos. 75,001 to 87,500.

Cable Meetings.—Yesterday, at 33, Old Broad Street, E.C., meetings of the Direct West India Cable Co. and the Halifax and Bermudas Cable Co. were held.

Dick, Kerr & Co., Ltd.—The meeting of this company was held yesterday at Cannon Street Hotel. Our report will appear next week.

Hove Electric Lighting Co., Ltd.—The directors have declared an interim dividend at the rate of 8 per cent. per annum for the half-year ended June 30th, payable on October 15th. This is at the same rate as the 1905 interim declaration.

Yorkshire Electric Power Co.—The half-yearly meeting of this company was held at Leeds on Tuesday, Mr. A. G. Lupton, presiding.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.		No. of wks.	Total to date.		Route miles open.	
		£	£*		£	£*		*
Aberdeen	Sep. 19	3,220	+ 300	16	25,360	+ 462	14·4	..
Ayr	„ 15	633	+ 58	18	7,231	+ 27	8	..
Bath	„ 24	2,024	+ 388	38	31,997	+ 5,826	13	..
Belfast	„ 21	7,074	+3,114	38	125,204	+38,850	40	+ 6½
Birkenhead	„ 23	2,110	+ 43	25	27,382	+ 359	13·52	..
Blackburn	„ 19	2,181	+ 104	25½	27,567	+ 1,726	13·62	..
Blackpool Corp.	„ 20	4,000	+ 425	25	41,018	+ 2,565	11·87	..
„ —Fleetw'd	„ 22	2,598	+ 501	12	19,137	+ 2,649	8·25	..
† „ —Lytham	„ 2	825	+ 155	39	12,897	+ 1,353	7½	..
Bolton	„ 23	4,167	+ 236	25	55,095	+ 3,955	26	+ 1
Bournemouth	„ 19	4,197	+ 664	24½	46,388	+ 9,299	18·75	+ 6¾
Bradford	„ 22	9,004	— 95	25	118,499	+ 4,746	53	+ 2
Brighton	„ 23	2,191	— 83	25	28,285	..	9·5	..
Bristol	„ 21	10,746	+ 679	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Sep. 14	495	+ 28	37	8,180	+ 690	3·65	..
Barnsley	„ 14	334	+ 25	„	6,068	+ 78	..	..
Barrow	„ 14	634	+ 91	„	9,721	+ 622	5·37	..
Cavehill	„ 14	266	+ 180	„	3,476	+ 1,509	..	..
Devonport	„ 14	1,056	+ 99	„	17,100	— 158	8·85	..
Gateshead	„ 14	2,043	+ 135	„	35,848	+ 1,971	11·25	..
Gravesend, N'fleet	„ 14	595	+ 62	„	9,132	+ 411	6·5	..
Greenock	„ 14	1,660	+ 220	„	25,193	+ 1,382	7·25	..
Hartlepool	„ 14	740	+ 150	„	11,412	+ 1,479	6·72	..
Kidderminster	„ 14	296	+ 19	„	4,671	+ 6	..	..
Leamington	„ 14	368	— 27	„	6,665	+ 2,662	3	..
Merthyr	„ 14	432	+ 48	„	7,283	+ 200	2·9	..
‡Metropolitan	„ 14	8,295	+1,658	„	127,945	+30,045	22	..
Middleton	„ 14	799	+ 201	„	13,416	+ 568	8·5	..
Mid. Joint Com'tee	„ 14	20,565	— 84	„	376,904	+17,779	..	..
Oldham — Ashton	„ 14	1,202	+ 79	„	21,187	+ 618	9·13	..
Peterborough	„ 14	314	+ 12	„	4,935	— 301	5·31	..
Potteries	„ 14	3,672	+ 160	„	65,494	+ 3,212	29	..
Rothesay	„ 14	618	+ 156	„	9,724	+ 1,554	2·75	..
Southport	„ 14	784	+ 96	„	12,436	+ 315	8·17	..
Swansea	„ 14	1,905	+ 160	„	31,183	+ 4,963	5·5	..
Tynemouth	„ 14	739	+ 154	„	10,269	+ 55	3·75	..
Weston-s-Mare	„ 12	705	+ 152	„	6,468	+ 476	3	..
‡Worcester	„ 14	688	— 53	„	10,748	— 807	5·75	..
Wrexham	„ 14	253	+ 17	„	3,877	+ 73	..	..
Yorks. Wool. Dist.	„ 14	1,965	+ 564	„	33,598	+ 9,552	17	..
Miscellaneous	„ 14	265	+ 19	„	3,994	— 582	..	..
Burnley	„ 22	2,437	+ 108	37	..	..	7·5	..
Burton-on-Trent	„ 23	574	— 34	25	7,882	— 472	9·5	+ 1
Bury	„ 16	2,013	..	24	24,557	..	10·5	..
Cardiff	„ 15	4,435	+ 369	24	52,231	— 24	15·87	..
Carlisle	„ 22	405	+ 20	38	7,165	+ 17	..	..
Chatham and Dist.	„ 20	1,769	+ 348	38	25,900	+ 285	12·84	+ 3·5
Colchester	..	..	..	..	..	..	..	..
Cork	„ 20	1,083	+ 64	38	18,573	— 207	9·89	..
Croydon	„ 21	2,985	+ 178	16	26,027	+ 1,908	11·25	+ ·5
Darlington	„ 15	446	+ 20	24	5,247	+ 182	4·87	..
Darwen	„ 21	548	+ 32	25	6,523	+ 282	4·36	..
Dover	„ 22	568	+ 73	25	7,269	+ 1,072	4·75	+ 1½
Dublin	„ 21	10,486	+ 749	12	69,473	+ 3,889	18·75	+ ·25
Dundee	„ 19	2,181	+ 231	18	20,605	+ 4,211	13	+ ·5
East Ham	„ 22	1,805	+ 90	25	23,944	+ 2,169	8	+ ½
Exeter	„ 21	642	— 52	25	7,815	— 323	4·25	..
Glasgow	„ 22	35,622	+3,733	19	277,980	+24,622	81·75	+ 6
†Halifax	Aug. 29	1,760	+ 89	22	38,419	+ 1,044	37	+ 1·5
Hastings	Sep. 20	2,271	..	..	..	..	..	..
Huddersfield	„ 22	3,018	+ 196	25	39,048	+ 3,584	28	..
Hull	„ 22	4,522	+ 208	25	57,070	+ 1,340	13	..
Ilford	„ 22	960	+ 28	24	12,522	+ 211	6·37	..
Ilkeston	„ 19	292	+ 56	25	3,502	+ 382	3·5	..
Ipswich	„ 22	955	— 13	25	12,077	— 133	10·5	..
Isle of Thanet	„ 22	2,130	+ 270	38	27,888	+ 472	11	..
Kilmarnock	„ 22	390	+ 8	19	3,183	— 60	4·25	..
Kirkcaldy	„ 19	608	+ 171	..	..	..	7·5	..
Lan'kshire Trm. Co.	„ 20	1,890	+ 57	38	33,382	+ 5,839	12·56	+ ½
Leeds	„ 15	13,175	+1,875	24	155,067	+ 9,142	96	+ 6½
Leicester	„ 22	4,390	+ 119	38	..	..	..	..
Leith	„ 15	1,125	+ 354	17½	9,759	+ 4,650	6	+ 1
Liverpool	„ 15	22,435	+ 813	37	399,083	+ 6,882	104	+ 1
‡L.C.C.	„ 15	52,637	..	24	637,061	..	98½	+47
London United	„ 14	13,312	+1,229	38	240,816	+16,545	..	..
Lowestoft	„ 22	615	+ 51	52	9,626	— 493	3·5	..
Manchester	„ 22	28,309	+2,528	25	350,163	+21,929	146	+21
Newcastle	„ 22	8,054	+ 528	25	102,835	+ 6,390	25·5	..
†Newport	„ 15	690	+ 82	24	15,822	+ 907	14·5	+ 1·5
Northampton	„ 21	917	+ 44	25	11,802	+ 198	5·5	..
Oldham	„ 23	3,655	+ 326	26	47,956	+ 4,625	23·75	..
Pontypridd	„ 22	331	+ 26	25	4,311	+ 87	3·5	..
Portsmouth	„ 22	4,392	+ 117	25	57,013	— 671	14·5	..
Preston	„ 12	1,665	+ 357	..	..	..	10	..
†Reading	„ 20	629	— 34	25	16,552	+ 21	7·5	..
Rochdale	„ 22	7,125	+ 410	24	27,553	+ 7,811	20·6	..
Rotherham	„ 20	1,010	— 3	25	12,693	+ 1,205	9·33	..
Salford	„ 17	8,881	+ 469	24	111,494	+ 2,517	38·9	..
Sheffield	„ 23	10,531	+ 620	26	138,743	+ 8,945	35·75	+ 1½
Southampton	„ 19	2,130	+ 77	24½	25,582	+ 296	..	..
Southend-on-Sea	„ 19	1,072	+ 89	25	12,126	+ 558	6	..
Stalyb'dge, Hyde, &c	..	..	..	..	..	..	..	..
Stockport	..	..	..	..	..	..	..	..
Sunderland	„ 28	2,765	+ 97	25	37,141	+ 1,982	10·87	..
Swindon	..	..	..	..	..	..	..	..
Tyneside	„ 19	924	+ 109	38	17,454	+ 1,399	8·87	..
†Walthamstow	„ 15	669	+ 168	24	16,123	..	10	..
West Ham	„ 20	4,516	+ 262	25	58,167	+14,022	14·7	+ 1·4
Wolverhampton	„ 19	1,645	..	..	..	..	10	..
Yorks. W. Riding	„ 23	1,659	+ 2	38	31,826	..	..	..
Baker St.-Waterloo	„ 22	3,000	..	12	16,240	..	4	..
Cen. London Rly.	„ 22	11,882	— 274	12	65,887	— 2,885	6	..
City & S. Lon. Rly.	„ 23	5,579	+ 641	12	29,623	+ 1,764	6·25	..
Dublin-Lucan Rly.	„ 21	280	+ 7	12	1,746	— 51	7	..
G. N. and City Rly.	„ 22	3,340	+ 241	12	18,820	+ 1,363	3·5	..
L'pool Overh'd Rly.	„ 23	2,906	— 64	12	18,732	— 575	6·65	..
Mersey Railway	„ 22	3,348	+ 249	12	19,647	+ 1,460	4·5	..
Metropolitan Rly.	„ 28	29,294	..	12	172,524	..	70·5	..
Met. District Rly.	„ 23	15,035	+1,266	12	86,794	+ 8,984	24	..
Anglo-Argentine	„ 23	30,944	+4,121	38	564,441	+62,608	48	..
§Auckland	„ 14	9,710	+ 771	36½	90,006	+ 6,032	18·64	..
§Brisbane	Aug.	14,186	+1,415	..	..	..	..	..
§Brit. Columbia Rly.	July	18,433	+2,807	4½	18,433	+ 2,807	..	..
†Bu'n's A'r's E.T.Co.	Aug. 25	1,203	— 2	34	46,034	+ 7,480	24	..
Bu'n's A'r's-Blgr'no	Sep. 16	7,551	— 16	37	126,055	+ 6,589	..	..
Calcutta	„ 22	6,455	+ 536	..	..	..	..	..
§Cape Electric T. Ld.	..	..	..	..	..	..	..	..
§Geneva	Aug.	8,952	+ 352	..	..	..	..	..
§Kalgoorlie	„	5,005	..	35	34,892	..	20·5	..
Madras	Sep. 15	983	+ 200	37	16,197	+ 1,736	..	..
Perth (W.A.)	„ 21	2,662	+ 106	38	55,438	+ 3,359	24·25	+ 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Much anxiety exists with reference to the monetary situation, and another rise in the Bank Rate is freely predicted. This gives an added note of nervousness to all the markets; scarcely one department escaping the general atmosphere of weakness. At the end of September it is, of course, the usual thing for money to become "tight," but this year the regular stringency is aggravated by the enormous speculation in American Railroad shares in the United States. Besides the ever-popular Yankees, copper has drawn an immense amount of gambling to its market, the demand being almost ahead of the supply, thanks largely to the increased requirements of electrical industries—most particularly in the telegraph and telephone trades.

As with most of the other investment sections, dulness pervades the electricity supply market. It is with some regret that the loyal follower of the shares has to chronicle a revulsion in the better tone that prevailed two or three weeks ago. Indications were not wanting at that time that the movement might lack stability, and we pointed out that the advertising of a particular group was responsible for the little revival. The set-back, however, has made no great inroad upon prices. Bromptons, City Preferences and County Preferences are ¼ lower, and so are South London Ordinary. Smaller falls are marked in Charing Cross Ordinary and South Metropolitan Preference. Hove shares improved to 8¼.

Falls have occurred in British Electric Traction issues, a few sales knocking down the prices of the shares and of the Debenture stocks. There is not much activity in the market, and this lack of elasticity is strongly brought out at periods of general depression. Anglo-Argentine Trams weakened in sympathy with a relapse in Argentine Railway securities, and Belgrano shares are ½ down for the same reason. Calcutta Trams continue a dull market. London United Trams are unchanged, in spite of the decline in British Electric Traction.

Metropolitan Railway stock is still in melting mood, being down to 60 upon the continued decreases shown by the traffics. What would have happened had the company raised its fares—and a revolution—can only be imagined by the stockholders. Districts are steady amid all the storm of petitions and indignation meetings. Some people—travellers on other lines, and those holding District stock—ask why a railway company cannot charge what fares it pleases, so long as the Parliamentary limits are not overstepped. If the present agitation succeeds, why should not passengers by other lines also bring their fares to Parliament and demand remission? Travellers by the Central London, for example; the company's Ordinary stock steadily sinks, as though in some apprehension of what the Twopenny Tubers might do. City and South London is a point lower at 43.

London Motor Omnibus Preference picked up to 3¾, the Ordinary remaining about 25s. The London General Omnibus Co. has evidently some few troubles yet to conquer in regard to its motor traction, judging by the tone adopted the other day by one of its officials, who was discussing the heinousness of the suggestion that omnibus companies should pay rates for the routes they traverse, as well as for the ground upon which their premises stand. Sunderland District Electric Debentures at 88½ are 2 points better.

In the Telegraph market a fall of 30s. in Great Northerns has lowered the price to 37. Anglo "A" is rather easier. Indo-Europeans receded to 60. The only rise in this department is one of ⅛ in Eastern Extensions, making them 14¾. Telephones are unaltered. Manufacturing shares have moved but little, Babcocks at 4⅛ are 2s. 6d. down. Callenders, Henley's, and Dick, Kerr show no movement.

The Calcutta Electric Supply Corporation, Ltd.—

The directors have declared an interim dividend on the paid-up share capital of the company at the rate of 6½ per cent. per annum for the half-year ended June 30th last. The dividend will be payable on November 15th. Last year the interim declaration was at the same rate. The number of units delivered to consumers during the four weeks ended July 27th, 1906, were 574,479, compared with 416,207 units in the corresponding four weeks of the preceding year. The number of units delivered to consumers during the five weeks ended August 31st, 1906, were 646,142, compared with 567,544 units in the corresponding five weeks of the preceding year.

Babcock & Wilcox, Ltd.—

An interim dividend at the rate of 8 per cent. per annum for the half-year ended June 30th has been declared on the ordinary shares. This is at the same rate as last year's interim.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years.				Closing Quotations Sept. 18th.	Closing Quotations Sept. 25th.	Business done week ended Sept. 25th, 1906.		Rise + or Fall —
			1902.	1903.	1904.	1905.			Highest	Lowest.	
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾ — 4	3¾ — 4	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	87 — 92	87 — 92	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	22½%	31½%	66⅛ — 68⅛	66⅛ — 68⅛	67⅛	66⅞	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	113⅛ — 114⅛	113⅛ — 114⅛	114⅛	113⅝	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	24 — 24½	23⅝ — 23¾	24 1/16	23¾	— ⅜
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —105	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..
1,992,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97½ — 98⅓	97 — 99	98⅛	97¼	— ½
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅞ — 3⅞	3⅞ — 3⅞	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¾ — 9¼	8¾ — 9¼	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
60,710£	Direct United States Cable	20	8½%	8 %	8½%	4½%	15½ — 16	15½ — 16	15¾	..	..
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	144 —147	144 —147	146⅞	145¼	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90 — 92	91¾	90¼	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	..	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14⅜ — 14⅞	14⅛ — 15	14⅜	14⅜	+ ⅛
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½ —107½	105½ —107½	..	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5½%	10⅞ — 11¼	10⅞ — 11¼	11 1/16	10¾	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝	14⅜ — 14⅝	14⅝	..	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	37½ — 39½	36 — 38	37¼	37¼	—1½
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	59½ — 61½	59 — 61	60⅞	60⅛	— ½
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	1 1/16 — 1 1/16	1 1/16 — 1 1/16	21/3	..	..
86,492	Do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1 1/16 — 1 1/16	1 — 1	..	..	— 1/16
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	110	..	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	109 —111	109 —111	110½	109¾	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 7/16 — 5 7/8	5 7/16 — 5 7/8	5 11/16	5 9/16	..
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98 —100	98 —100	..	..	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	102½ —104½	102½ —104½	103½	..	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7¼ — 7½	7¼ — 7½	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	101 —104	101 —104	102½	101⅜	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	129 —132	131½	129½	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛	7⅛	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5½	5¼ — 5½	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜ — 10⅛	9½ — 10⅛	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 55,001 to 58,008	2½	Nil	Nil	Nil	Nil	3/16 — 4/16	3/16 — 4/16	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100⅜ —103½	100⅜ —103½	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14⅜ — 14⅝	14⅜ — 14⅝	14⅜	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. ..	.. ..	..	..	..
553,380	Do. do. 4 % Debs. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	104	103⅜	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	3/16 — 4/16	3/16 — 4/16	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6¼ — 6¾	6¼ — 6¾	6 9/16	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4⅜ — 5⅜	4⅜ — 5⅜	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

....	Anglo-Argentine Trams. 400,000 to 450,000 ..	5	..	..	... %	... %	7 5/16 — 7 9/16	7¼ — 7⅜	7 7/16	7 5/16	— 1/16
100,000	Do. Nos. 430,008 to 910,007 and 560,008 to 580,007 ..	6	..	..	..	..	7 — 7¼	6⅞ — 7⅛	7 1/16	6⅞	— ⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅞ — 6	5⅞ — 6	5 9/16	5 1/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	103 —105	103 —105	103⅜	..	..
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	4⅛ — 4⅜	4 — 4⅛	85/-	81/3	— ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3⅞ — 4⅛	3⅞ — 4⅛	80/-	..	..
40,000	Do. do. 7 % Cum. Pref.	5	Nil	Nil	7 %	7 %	6½ — 6⅝	6½ — 6⅝	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106	104 —108	101	100½	+2
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	117 —120	118 —121	119½	..	+1
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —113	110 —113	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103½ —105½	104 —106	..	..	+ ½
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	102 —105	..	..	+1
133,901	British Electric Traction	10	8 %	6 %	8 %	8 %	5¼ — 6	5¼ — 5⅝	5⅜	5 3/16	— ⅛
161,427	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9¼ — 9⅝	8¾ — 9⅛	9⅛	9 1/16	— ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	115 —118	112 —116	115⅜	113⅜	—2½
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	92½ — 95½	92½ — 95½	..	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅞ — 6⅞ xd	6⅞ — 6⅞ xd	6	5¾	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	..	4½%	4½%	4½%	95 — 97	97 —100	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1¼ — 1⅜	1¼ — 1⅜	22/6	28/9	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	..	4 %	4 %	4 %	77 — 83	77 — 83	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	Nil	..	3/16 — 4/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅝ — 1¾	1⅝ — 1¾	29/4½	..	..
125,000£	Do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	83⅜	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3½%	3⅜ — 3⅝	3⅜ — 3½	65/-	..	— ⅛
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5¼	5 — 5¼	..	..	..
817,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106	105 —107	..	..	+1
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —106	102 —105	..	..	— ½
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8⅜ — 8⅞	8¼ — 8⅜	8 1/16	8 1/16	— ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8 — 8¼	7⅛ — 8⅜	..	..	— ⅛
850,000	Do. 4½ % 1st Deb. Stock	100	..	..	4½%	4½%	103 —106	103 —106	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½ — 11½	10½ — 11½	11	10⅜	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5¾	5⅜ — 5¾	5 1/16	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	110	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅜ — ⅝	⅜ — ⅝	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	21/9	21/3	..
220,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	83 — 85	84⅛	83½	—1
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	98½	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	73¾	73⅜	..
1,480,000	City and South London Railway	Stock	3½%	2½%	2½%	1½%	43 — 45	42 — 44	43⅜	42⅜	—1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	2½%	1⅝ — 1⅞	1⅝ — 1⅞	36/3	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends. ‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

Present Issue.	NAME,	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Sept. 18th.	Closing Quotations Sept. 25th.	Business done week ended Sept. 25th, 1906. Highest.	Lowest.	Rise or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	£1	..	..	10 %	..	1⅛ — 1⅞	1⅛ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	£1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
294,150	Do. do. 4½ % Deb. Stock	£100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	£10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	£10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,361	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,361	£5	Nil	Nil	2½‡	..	1½ — 1⅞	1½ — 1⅞	33/9	30/-	..
17,189	Do. "A" shares, 01—017,189	£5	Nil	Nil	2½‡	..	2¼ — 2⅜	2¼ — 2⅜	48/1½	..	..
844,023‡	Do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	£100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	£2	6 %	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	£2	7 %	7 %	7 %	7 %	1⅞ — 2⅛	1⅞ — 2⅛	40/-	..	..
300,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	85 — 88	85 — 88	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	£10	5 %	5 %	5 %	5 %	9 — 9⅛	9 — 9⅛	..	..	..
300,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	£10	..	3	4	4	3¾ — 4	3¾ — 4	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	£10	..	7	7	7	10¼ — 10⅝	10 — 11	..	..	..
80,000	Do. do. 5 % Mort. Debs.	£100	..	5	5	5	101 —102	101 —103	..	..	+ ½
300,000	Henley's (W. T.), Telegraph Works, Ord.	£5	20 %	15 %	15 %	15%	12 — 13	12 — 13	..	..	..
200,000	Do. do. 4½ % Pref.	£5	4½%	4½%	4½%	4½%	5⅛ — 5¾	5⅛ — 5¾	..	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107⅞ —109⅝	107⅞ —109⅝	108½	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	£10	10 %	10%	5 %	10%	17 — 18	17 — 18	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	£10	1½%	13%	1½%	Nil	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
10,000	† Do. do. Pref. £10 paid	£10	5 %	5 %	5 %	5 %	4⅛ — 6½	4⅛ — 6½	..	..	..
600,070	London United Trams (1901), 1 to 50,007	£10	..	8 %	6 %	3 %	8 — 8⅛	8 — 8⅛	..	..	..
899,980	Do. do. 60,008 to 100,000 (£6 paid)	£10	..	8 %	6 %	3 %	3¾ — 4⅛	3¾ — 4⅛	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	£10	..	5 %	5 %	5 %	8½ — 9⅛	8½ — 9⅛	..	..	..
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	93 — 96	93 — 96	93½	..	..
314,016	Metropolitan Electric Trams, Defd.	£1	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	..	..	..
500,000	Do. 5 % Cum. Pref.	£1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	..	..	..
850,000	Do. 4½ % Deb. Stock Red.	£100	..	..	4½%	4½%	98⅜—100⅝	98⅜—100⅝	..	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	£5	..	..	6 %	6 %	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	£10	..	5 %	5 %	4 %	6½ — 7½	6½ — 7½	..	..	..
24,500	Do. 5 % Cum. Pref.† 1 to 20,000 & 40,001 to 44,500	£10	..	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..
245,000	Do. 4½ % Deb. Stock	£100	..	4½%	4½%	4½%	100 —103	100 —103	100⅜	..	..
37,350	Telegraph Construction and Maintenance	£12	20 %	20 %	15 %	15 %	33½ — 35½	33½ — 35½	33¼	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	£100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	89⅜	..	..
540,000	Waterloo & City Railway, Ord. Stock	£100	3½%	3½%	3½%	3½%	103 —106	103 —106	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	£5	3½%	3 %	Nil	Nil	⅜ — 1½	⅜ — 1½	..	..	..
66,666	Do. 6 % C. P., 80,001 to 80,000 & 125,001 to 141,666	£5	..	6 %	Nil	Nil	2½ — 3½	2½ — 3½	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	£100	..	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	£5	..	5 %	5½%	4 ⅝%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	£100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	£5	8 %	10 %	10 %	10 %	8¼ — 9	8⅛ — 8⅜	..	..	— ¼
19,623	Do. do. 7 % Cum. Pref.	£5	7 %	7 %	7 %	7 %	7⅛ — 8	7⅛ — 8	..	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	£5	10 %	8 %	8 %	5 %	4⅛ — 5	4⅛ — 4⅞	96/9	91/3	— ½
80,000	Do. do. do. 4½ % Cum. Pref.	£5	4½%	4½%	4½%	4½%	4⅛ — 5	4⅛ — 5	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	£5	4½%	4½%	4½%	4½%	4 — 4⅛	4 — 4⅛	92/6	..	..
420,000	Do. do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,436	Chelsea Electricity Supply, Ord.	£5	4½%	5½%	6 %	6 %	5⅜ — 5¼ xd	5⅜ — 5¼xd	5 1/16	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —109	106 —108	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	£10	5 %	5 %	6 %	6 %	10 — 11	10 — 11	10 1/16	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	6 %	6 %	6 %	6 %	11⅜ — 12⅝	11⅛ — 12¼	12	..	— ⅛
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	123⅛	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	£100	4½%	4½%	4½%	4½%	101 —104	100 —103	..	..	—1
40,000	County of Durham Electrical Power, Ord.	£2	4 %	4 %	£3 7 0	4 %	2⅛ — 3⅜	2⅛ — 3⅜	..	..	..
50,000	Do. do. do. 5 % Pref.	£5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5 1/16	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4½%	5 %	8⅜ — 9⅛	8⅛ — 9	..	..	— ⅛
30,000	Do. do. 6 % Pref., 40,001—60,000	£10	6 %	6 %	6 %	6 %	11⅜ — 12⅛	11⅛ — 12	..	..	— ¼
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	109½	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	103	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	7 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
80,000	Do. do. 6 % Cum. Pref.	£5	6 %	6 %	6 %	6 %	4⅜ — 5⅜	4⅜ — 5⅜	..	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	£100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
10,000	Folkestone, 1 to 10,000	£5	..	5½%	5½%	5½%	5¼ — 5⅝	5¼ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	£5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	£100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	£5	..	8½%	8½%	9 %	7⅛ — 8⅜	8 — 8⅛	..	..	+ ⅛
10,000	Do. New (£6 10s. paid)	£8	..	8½%	8½%	9 %	6¼ — 6⅞	6¼ — 6⅞	..	..	..
87,300	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	£100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	12½%	12 %	10 %	9⅜ — 10⅜	9⅜ — 10⅜	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£5	Nil	Nil	3 %	4 %	1⅞ — 2⅜	1⅞ — 2⅜	..	..	..
60,000	Do. do. do. 6 % Pref.	£5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜	..	..	..
874,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	£5	7½%	8½%	10 %	10 %	8 — 8⅛	8 — 8⅛	8 7/16	8 1/16	— ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	£5	4½%	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	£100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	£5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	£5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	£10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	£100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	£5	..	6½%	7 %	7 %	6½ — 6⅞ xd	6½ — 6⅞	6 5/16	..	..
50,000	Do. 4 % Deb. Stock	£100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	12½%	10 — 11	10 — 11	10⅜	..	..
20,000	Do. do. 7 % Pref. 20,001 to 40,000	£5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	£100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	2½%	4 %	4 %	4 %	2 — 2½	2 — 2½	..	..	..
80,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 78	74 — 78	..	..	..
65,000	South London Electricity Supply, Ord.	£5	12½%	8 %	4 %	4 %	3 — 3½	2⅞ — 3⅛	3 7/8	..	— ⅛
103,700	South Met. Elec. Lt. & Power (Ord.	£1	Nil	Nil	Nil	2½%	⅛ — ¼	⅛ — ¼	..	..	..
85,368	*(Late Blackheath and Greenwich Dist. E.L.Co.)* 7 % Pref.	£1	Nil	7 %	7 %	7 %	1⅛ — 1 3/16	1⅛ — 1⅛	..	..	+ 1/16
148,292	4½ % 1st Deb. Stk.	£100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	£5	5 %	5 %	5 %	5 %	3¾ — 4	3¾ — 4	7 5/16	..	..
30,000	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	..	..	..
90,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	£100	..	..	4½%	4½%	99 —102	99 —102	..	..	..
110,000	Westminster Electric Supply, Ord.	£5	12 %	15½%	14 %	13 %	9⅜ — 10⅜	9⅜ — 10⅜	10 3/16	9 15/16	..
27,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.	£5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 5/32	5 1/16	..

Shares not officially quoted:—Mackay Companies, ord., 75—77. Pref. 74—76.

† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 4 per cent. September 18th, 1906).

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING AUGUST, 1906.

On the whole the returns of electrical trade for August, given below, are a satisfactory record of improving business, especially in comparison with the returns of a year ago.

Although the export total of the month, at £124,031, is below the July total, and, in fact, somewhat below the monthly average obtaining during 1906, yet that average is £13,000 above the corresponding figure for 1905. Furthermore, the re-exports, which stand at £12,733, are more than double those of August, 1905, and have only been exceeded once during the past 18 months.

The electrical imports, which totalled £163,055, or £19,000 above those of July, have only on one occasion (February, 1906) been exceeded in value during the past 18 months. The improved monthly average obtaining during 1906 is, in this case, even more marked; it being some £25,000 above the corresponding figure for 1905.

The individual totals of the exports are, of course, generally lower than in July, and do not call for special comment; the Argentine may, however, be noted as our most prominent customer.

The import items are generally improved, the cable imports especially so; telegraphic and telephonic imports are, however, somewhat less in value than last month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	417	815	296	34	10	67	7	...	7	2	...
Germany and German West Africa	496	61	150	18	13	614	17	...	98	...	...
Netherlands	54	310	215	57	...	45	19	...	...	...	...
Dutch Borneo, Java and Ind. Possessions ...	11	...	74	11	...	...	...	...	...	...	...
Belgium	217	32	...	3	16	286	...	...	390	28	...
France and French Indo-China	53	5	63	...	9	221	94	...	...	...	...
Portugal, Azores, Portuguese Indies & Portuguese Africa	929	63	279	11	27	546	...	...	213	95	...
Spain and Canary Isles	313	...	76	72	1,155	774	...	...	...	...	...
Italy and Austria-Hungary	58	...	...	5	75	123	490	...	...	...	...
Greece and Turkey	...	28	48	34	10	620	...	...	...	...	...
Egypt and Tunis	358	219	320	10	107	246	10	...	...	80	...
China and Siam	1,690	557	610	103	61	90	11	...	27	83	...
Japan	380	7,701	71	35	1,166	4,519	1,620	18	...	523	...
U.S.A. and Philippines	405	164	...	347	70	100	10	...	...	12	...
Mexico, Peru and Uruguay	53	2,155	223	65	10	...	15	...	83	3,600	...
Chili	406	242	328	92	...	...	311	...	19	...	...
Brazil	360	...	88	256	19	1,528	...	3	31	...	...
Argentine	4,689	9,091	883	316	50	10,315	1,124	5	755	40	...
Channel Isles, Gibraltar and Malta	233	241	564	102	20	75	...	...	55	...	...
British West Africa	104	307	43	...	149	695	1	...	4	39	...
Cape of Good Hope	2,414	165	568	267	34	2,134	180	...	3	22	...
Natal	1,289	1,287	318	248	106	1,647	18	...	...	13	...
Zanzibar, Brit. East Africa, and Mauritius ...	...	...	...	70	...	35	...	...	69	...	...
India	3,959	1,013	659	600	425	6,533	239	21	54	957	...
Burmah	22	1,960	558	31	...	...	...	...	...	...	...
Ceylon	430	...	115	...	39	...	...	...	...	...	...
Straits Settlements, Fed. Malay States & Labuan	171	126	351	67	43	129	...	...	107	219	...
Hong Kong	96	35	160	22	...	1,376	...	64	...	...	...
West Australia	368	96	37	235	279	867	17	...	...	...	...
South Australia	1,185	75	126	15	5	...	809	...	...	...8	...
Victoria	225	497	223	290	24	349	18	...	...	12	...
New South Wales	1,866	467	755	424	51	1,312	111	9	37	121	...
Queensland	...	152	...	18	...	48	4	...	...	...	...
Tasmania	4	...	53	...	...	12	...	...	...	...	...
New Zealand	218	658	430	224	...	4,300	33	6	158	71	...
Canada and Newfoundland	200	...	145	64	30	230	1,610	...	29	...	...
British West Indies and British Guiana ...	...	...	3	...	...	22	22	...	15	...	...
Total, £	23,673	28,522	8,842	4,146	4,003	39,858	6,790	126	2,154	5,917	...

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	51	336	...	25	...	1,159	478	7	12,634	...	...
Holland	870	2,733	1,308	2,846	347	2,114	400	4,663	1,089	...	...
Germany	1,992	14,450	1,620	428	87	13,509	4,006	451	1,877	...	...
Belgium	526	2,453	1,174	3,069	83	9,944	374	1,864	16,404	...	808
France	3,252	5,400	1,539	493	1,463	2,384	446	1,890	1,947	65	...
United States	2,005	4,233	631	50	56	29,165	131	323	631	408	...
Total, £	8,697	29,605	6,272	6,911	2,036	58,275	5,835	9,198	34,582	473	808

Additional Imports: Italy, electrical cable, £354; New South Wales, electrical machinery, £10.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	4,378	100	310	217	230	2,416	...	310	4,557	170	...

TOTAL EXPORTS: £124,031

TOTAL RE-EXPORTS: £12,733

TOTAL IMPORTS: £163,055

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

ELECTRICITY IN SCOTTISH COLLIERIES.

[COMMUNICATED.]

During the past two years the developments in the collieries of Scotland, especially in the adoption of electrical machinery, have been very great. This is very clearly shown in the Government report and list of mines in the eastern district, wherein Mr. McLaren has noted those pits where electricity is in use and those in which coal-cutters are employed.

Next year it will be seen that there has been an even greater increase in the number of managers who have brought their pits up-to-date, as, not only is a large amount of work at present in hand, but many inquiries are being dealt with by the contractors in the country.

The United Collieries, owners of something like 70 pits, under the energetic chairmanship of Mr. Mungall, seem determined to retrieve their financial position by judicious expenditure on coal-cutters at several of their collieries. By this means they are opening out seams which could not otherwise be worked at a profit, and they are also boring in one or two new fields.

Messrs. Wm. Baird & Co., who now own about 50 pits, and have hitherto been somewhat backward in adopting electricity, are gradually bringing their collieries into line in a similar manner. They have recently been testing in the Kilwinning district, so far with satisfactory results, a disk-type, two-motor coal-cutter, of a make which has given considerable trouble at the Cadzow Coal Co.'s pit near Hamilton. So annoyed, in fact, were the latter people with the delays which occurred that they abandoned their intention of installing electric haulage, and are at present erecting steam plant for this purpose. Messrs. Wm. Baird & Co. have lighted the new pit near Glenboig, and will shortly be putting in electric machinery and possibly coal-cutters there. An electric haulage scheme in one of their pits near Muirkirk is also expected to mature in a few months.

Messrs. Jas. Nimmo & Co. have always been amongst the most progressive of coal-masters, and claim that they have more cutters at work than all other colliery owners in Scotland together. Their new pit at Lenzie is likely to be as well equipped as any of its size; the electric generators will eventually total 1,500 or 1,600 H.P., and will drive haulage, pumping, face-conveyors, and coal-cutters below ground, and the whole of the surface plant and coke-ovens above, with the exception of the winding and the ventilating fan. Quotations are now being considered for the first of the three-phase generating sets with the power-house equipment.

The Tarbrax electric winding plant is the first plant of its kind in Scotland. From an engineering point of view it appears to be eminently successful, and the financial results are anxiously awaited. Similarly, the three-phase coal-cutters at work in the Bowhill Co.'s pit in Fife have acted splendidly for some months but, in view of many previous failures to produce a reliable machine of this type, it is desirable to wait for the reports of a more lengthy trial.

Another firm at present considering offers for electric plant is that of Messrs. R. & J. Durie, at Tranent. In this case the modest size of 100 KW. is contemplated for driving two cutters, and to provide for future developments. It is interesting to note that this pit (Elphinstone) still possesses parts of the first electric coal-cutter ever used in Scotland. A neighbouring pit belonging to the Ormiston Coal Co. has only recently discarded its lighting plant which was installed about 30 years ago.

A very interesting experiment is at present being tried at one of the Carron Co.'s pits near Falkirk. This company is only just considering the purchase of its first cutter, although its ironworks have for some time been electrically equipped. In order to decide on the best machine to adopt, five firms have been asked to send their machines on hire for periods varying from 10 days to a month. These include one of the bar type, two English and one Scottish disk-type machines, and a chain machine of American design. A strong prejudice exists in Scotland against the last mentioned for holing in hard material, owing to several types having been put on the market which were far too weak for the work required of them. The disk machines have, perhaps, hitherto given most satisfaction in the neighbourhood, but all users look with interested eyes to the results which should be known in October.

Fife, which, with Lincolnshire, possesses the proud distinction of using more electrically driven than air-compressor coal-cutters, has developed, and is still doing so, enormously. Five or six of the principal companies are busy boring or sinking now. Two-thirds of the pits have electric plant already at work. The most recent additions to the list in the way of large plants are the Donnibristle Coal Co. and the Earl of Rosslyn's collieries, the latter having adopted three-phase machinery. In the autumn a motor-haulage gear in connection with the new plant, for hauling the tubs over about a mile of roadway to the pit bottom, will be installed. Pumping will be required at the Donnibristle pits in the near future, and at a later date haulage. The Coltness Iron Co. have been sufficiently satisfied with the results of their boring operations at Blairhill to commence sinking what will eventually be the deepest shaft in Scotland. Thos. Spowat & Sons are laying out sidings for a new colliery close to the Arthur pit of their Elgin and Wellwood field. It has been under consideration whether to install electricity for the winding in this case, either from the Fife supply station or from a private plant, but, up to the present, no decision has been arrived at. Other machinery will eventually be required, but, naturally, there will be many months of hard work ere the company is ready to consider this in detail.

If the Blairhill pit is the westernmost of the Fife collieries, enterprise is not lacking in the east, for near Pittenweem, miles beyond the last of the Fife Coal Co.'s pits, Mr. Penman is again boring at Falside. It is about two years since the last effort was abandoned, but better results are hoped for from the present attempt.

South of the Forth, the Grangemouth Coal Co. have, within the last three or four months, purchased their first electric coal-cutter. One of the bar type was selected (largely perhaps on account of first cost) and, if the results prove as satisfactory as were hoped for, further machines will be installed before the end of the year. Their neighbours, the Carriden Coal Co. at Boness, are suffering from what can only be described as "hard luck." Boring for a second shaft on the sea shore was commenced last year in the anticipation of reaching coal in the spring at about 80 fathoms. At somewhat more than double this depth the bore was abandoned, and a second one tried rather further back. This has now passed 280 fathoms without touching a suitable seam. Whether there will ever be need of the generating plant and motors which should have been required long ago it is hard to say. Two miles to the west the Kinneil Coal Co., after a life of over 30 years, are considering the question of converting some portions of their machinery from steam to electric driving. Whether business will result at present is somewhat doubtful, but the surface lighting will almost certainly be undertaken before the coming winter.

The Clyde Valley Electrical Power Co., who are still very short of customers to repay them for their enormous outlay on machinery and cables, have obtained a most satisfactory consumer in Mr. J. Watson's Earnock Colliery. A couple of two-phase coal-cutters were ordered a few months ago, and nearly a dozen will be needed as the seam is opened out more. Motors for other purposes will also be connected and the adjacent pits of the same company will doubtless follow suit. As one of the Supply Co.'s directors is chairman of the collieries, there was naturally a strong inducement to show what economy could be effected by eliminating a separate generating station. A near neighbour, Messrs. Merry & Cunninghame, at Auchenraith, will very probably follow Earnock's lead if results are good. The same company are almost ready also to receive offers for plant, and later for cutters, haulage and pumping at the North Motherwell Collieries. It is scarcely probable that in this case a supply will be taken from the public mains, but, until contracts are actually placed, it is unsafe to make assertions.

In the Hamilton district, just across the Clyde, the electrically-worked pits almost monopolise the field. The Bent Colliery installed motors for haulage only in the spring; the Cadzow Co. have already been mentioned, and so has John Watson, Ltd.; others, connected usually with one or other of the Barr families, form a line on the south of the river;

the Ross Colliery put in a plant quite recently, and have already one or two cutters at work from it. Their neighbours at the Bog pit started the new plant almost at the same time, and the Allanton pit has for long been in the forefront as regards coal-cutting. Although at the beginning of the year six or seven machines were at work in this pit, two chain machines of a new type and local make have been added since. These are for special work, cutting in a band of dirt some height from the floor, and they have been designed specially light in consequence. In addition a chain heading machine was purchased and the surface plant is being converted to electric driving. Further developments in the way of haulage are contemplated in the early autumn.

After passing Dalserf, another electrically-equipped colliery, the very stronghold of the air-compressing district is reached, upheld strenuously by Mr. J. Gemmels and the Darngavil Coal Co. at Swinehill. That the plant at the latter is superb is undeniable, but, as the same company have recently adopted electrical machinery at their pits in the Airdrie district, one is free to conclude that the results are short of perfection. Practically the only air-compressing plants now going in are one for the Fife Coal Co. under special conditions, and a large scheme at Dailly, where the Bargany Coal Co. have a pit which rains down a deluge of water in almost every part. Even in the case of the Glengarnock Iron and Steel Co.'s new shafts at Ardeer, where air-compression was necessary whilst sinking through the sand on the seashore, the permanent plant is to be entirely electrical, and some of this has already been purchased.

No matter where we turn throughout the Scottish coal fields, it is evident that for at any rate the next two years, a large amount of electrical machinery will have to be installed both for use for plants which are at present going in, and for developing the new pits which are being sunk. Many mine managers also in the older parts of the coal-fields are now face to face with the alternatives of having to close their collieries owing to the richest seams having been worked out, or installing mechanical cutters and other up-to-date appliances in order to work the thinner seams at a profit.

REVIEWS.

Electric Wiring Diagrams and Switchboards. By Newton Harrison. London: Crosby Lockwood & Son. Price 5s. net.

The author is instructor of Electrical Engineering in the Newark Technical School, U.S.A., and the book is intended for the guidance of wiremen, contractors, architects and others interested in the application of electricity to illumination and motive power.

The purpose is to give clear ideas of the underlying principles of rational wiring, and the apparatus most commonly met with on ordinary installations. The difficulty of referring to technicalities before explaining them is successfully evaded, although sometimes at the expense of the natural sequence of subjects. Almost every point is illustrated by examples, tables and diagrams.

After explaining the importance of wiring in electrical engineering, the author introduces the fundamental units, and gives memory rules, which clearly set forth their connection and combination.

The importance of drop of potential is emphasised. Methods are given of calculating this drop for simple and complex circuits, finding the circular mils of a cable, and arriving at its proper B. and S. gauge size, without a table. Numerous diagrams are provided, showing branching and networks, arranged for keeping the pressure approximately equal, and for various percentages of fall.

Several of these are somewhat clumsy, and while saving copper would, perhaps, make the finding of a fault a matter of much lost time.

The possible economies in laying out an installation due to proper proportioning of the three factors—fall of pressure, labour and material—are discussed.

One learns that the architects in America realise the benefit of providing runs, ducts, pockets and other facilities for wiring when planning new buildings. Incidentally, the author mentions the unique growth of the fan load in cities in summer. On some days in New York this demand is enormous.

The rules of the Board of Fire Underwriters and the conscience of the contractor are the extreme limiting conditions under which most installations in the States are carried out. Extracts from these rules are given; they include the provision that the volatilisation of all or any part of a wire in a steel conduit, by means of a short circuit, must not injure the conduit; and also, that if water is boiled inside the conduit the insulation must not dissolve but remain in its original condition.

The most general system in use in America is an iron or steel conduit one. Flexible steel and brass conduits are much used, however, as are also asphaltic paper conduits and one made of woven flexible insulating material. In damp situations the author prefers the use of rubber-covered wires clipped to insulators rather than conduit.

The good principle is advocated of treating whatever tube may be employed as if it were the actual conductor. This is certainly a healthy idea to be in the wireman's mind. In dealing with this subject, there is an uncorrected error in the middle paragraph on page 145, where "insulation" should be read in place of "installation."

Mr. Harrison has so much ground to cover that he does not deal with the purely mechanical details of wiring, such as jointing, methods of fitting and looping, but he gives the recipe of a soldering fluid which is largely made from hydrochloric acid. Even though the joints were afterwards cleaned, as he recommends, surely such a solution should be avoided.

Only a few simple methods of testing are described. A large part of the book is devoted to front and back diagrams of switchboards, showing connections and accessories for various lighting and power arrangements used with shunt and compound-wound dynamos and motors.

Methods of equalising the pressure with varying loads are given, and this leads on to the consideration of the principles of shunt and compound-generators and the use of rotary converters.

The last chapters are devoted to alternating currents, and the author succeeds in giving the non-mathematical reader a good and clear, if somewhat rudimentary, working conception of the phenomena met with. The explanations are simply and logically arranged. Arithmetical methods of obtaining the proper sizes of alternating-current mains are given.

One gathers that, in the States, electric wiring in its early days was of a highly imperfect and temporary nature, but that now, under stricter rules, it is greatly improving. In this country the material and workmanship of many of the earliest installations were excellent, while the stress of competition has now made inferior work common.

The book has 272 pages and a searching index, and could be read with advantage by most wiremen. It is not written for the thoroughly trained engineer, though even he might find many useful points to remember.

While it covers somewhat hackneyed ground, it covers it sensibly, and avoids the incoherence and inaccuracy of the majority of elementary books of its class.

Corso di Elettrotecnica. By Prof. Guido Grassi. (Vol. 2, 1906.) Rome and Turin: Roux & Viarengo. Price 16 lire.

The volume is divided into eight parts, dealing with distinct branches of study, and for convenience again split up into 20 chapters. Continuous and Alternating Motors, Transformers, Distributing and Transmission Systems, Sundry Applications, indicate the leading features of the work, which are accompanied by over 200 illustrations. An abundance of information is provided for students, and a considerable amount of valuable matters of reference for practical engineers. Each subject attacked is gone into in detail with frequent application, to demonstrate or prove results, of mathematical formulæ and graphic methods; many of the latter—particularly those concerning the calculation of polyphase conductors—appear to be set out on lines of a distinctly novel character, and whilst demanding the careful

attention of the reader to grasp the bearing and relation of the values that are given linear and angular dimensions, a significant result is obtained with a picture impressed on the mind that will not be readily erased. The author clearly indicates, in a concise summing up of the separate subjects, his own views as to advantages or disadvantages of the systems and apparatus dealt with, where this is possible, but in other cases where he finds that practice has not yet enabled him to make a definite choice between alternate methods which are still undergoing practical trial, he quotes examples of actual application, from the extended operation of which the reader will in due course learn the comparative efficiency or excellence.

The chapters written on "The Excitation and Regulation of Synchronous and Asynchronous Alternators" contain information over which the author has evidently exercised the utmost care to describe clearly, and illustrate fully with diagrammatic connections. The opinion is expressed that for heavy alternating work the highest voltage at which it is practicable to generate energy is 10,000 to 12,000, and that beyond these figures it becomes cheaper to install step-up transformers, whilst for small machines up to about 100 KW. it would be uneconomical to generate at a higher figure than about 3,000 volts; for any direct current system of transmission with a current up to 50 amperes, the limiting voltage is about 4,000 per generator. Details are given of the high tension direct current system now being erected at Montiers and Lione, a distance of 180 kilometres (112 miles); the station will contain 16 series machines, built for 3,560 volts and 73 amperes. The description given of switchboard apparatus does not compare favourably with the rest of the contents of the book, nor are the illustrations of this section so interesting.

Prof. Grassi can claim that he is one of the first to cover in his book a detailed account of the recent improvements which have made the mercury vapour lamps of some practical utility; Scott's system of transforming three-phase energy to two-phase, and *vice versa*, is also given attention, with an easily-comprehended graphic demonstration. For transmission lines over long distances the following formula is deduced for the weight (K) in kilogrammes of copper necessary to transmit a given number of kilowatts (W) a distance in kilometres (L) at voltage (V) and with a percentage loss (Y)—

$$K = \frac{150{,}000 \times L^2 W}{Y V^2 \cos^2 \varphi}.$$

This gives the result for single-phase working; with three-phase conductors there will be an economy of 25 per cent.

Entwurf von Schaltungen und Schaltapparaten (Schaltungstheorie). Vol. I. By Robert Edler. Hanover: Dr. Max Jänecke. Price 6 mark.

The scheming out of switchboards and switchgears to fulfil given conditions has always been carried out by a trial and error process, and often, when a solution has been reached at the expense of a good deal of time, it is difficult to decide whether it is the best possible solution.

Prof. Edler in this little book suggests a somewhat more logical method of attaining the result, and, when once his simple rules are grasped, the method should prove a useful and time-saving one, especially in the case of the more complicated switchgears.

From the nature of the subject, treatment by mathematical formulæ is out of the question, and thought at every step is still almost as necessary with the new as with the trial and error method, although the result is more directly reached, and is more reliable when reached. In employing the new process it is first necessary to have a clear idea as to the various operations which the gear is to perform. These separate operations or steps are then recorded in the form of simple diagrams showing which connections are essential, and also which connections are allowable, though not necessary. In these diagrams every connection point is lettered, and by means of these letters a table is next constructed showing, on one side, the necessary, and on the other, the additional allowable connections for each step of the operations. By arranging these connections in columns it is possible to see at a glance which connections can be permanently made, which remain unchanged for two, three or more steps, and which have to change at every step, and it is then a comparatively simple matter to devise a switch which will make the necessary changes.

Numerous fully worked-out examples of the application of this method to cases of arc lamps, glow lamps, battery charging, crane controlling and series parallel tramway controllers are given in the present volume, and in several cases the writer is able to show that his method leads to simpler solutions than those standardised by recognised makers.

In the second volume, to be published during the present year, it is proposed to deal with motor starting and regulating gear, switchboards for power and lighting, and arrangements for testing and measuring purposes.

Mis en Valeur des Moyennes et Basses Chutes d'eau en France: La Houille Verte. By Henri Bresson. Paris: H. Dunod and E. Pinat. 1906. Price 7.50 fr.

This work is published under the auspices of the Minister of Agriculture, and consists of a preface by M. Max de Nansonty, and three portions.

The first portion dealing with "Generalities and Theories" occupies about 115 pages—"La Houille Verte" is defined as "un revenu dont on use," in contradistinction to "La Houille Noire," which is "un capital que l'on mange." There are twelve chapters giving curves of variable water power, hydrographical considerations, water wheels and turbines, statistics and their utility, &c.

The second portion considers "Applications and Statistics," and contains about 120 pages giving particulars of water-power installations in the various departments of France.

The third part consists of 20 pages, and contains maps, tables, interesting graphical statistics, and various other information.

Replete as this book is with descriptions of all kinds of water-power installations, which in many instances are illustrated by photographs taken by the author himself, it is needless to say it forms a most valuable handbook to any electrical engineer engaged in such work.

The author is to be congratulated on producing a most readable work, as it is by no means the mere "dry-as-dust" collection of details and statistics which one might expect. As it is written very clearly, it will be of interest to those of the general public who contemplate utilising any available water-power either for lighting houses or driving factories.

MUNICIPAL TRAMWAYS ASSOCIATION.

Municipal Operation of Tramways.

By Councillor R. A. Smithson (Member of the Leeds Tramways Committee).

(*Abstract of Paper read on September 19th, 1906.*)

Leeds, which was practically the first large town to undertake the responsibility of municipalisation of its tramways, was, like many other corporations, almost forced into taking over their operation by reason, on the one hand, of the necessity of retaining, or rather in its case regaining, the control of its streets and roads, which, under the then dual control of the Corporation and the Tramways Co., had fallen into a deplorable condition, giving rise to constant complaints and much friction. The necessary Act was obtained in 1896, just ten years ago, and the revolution that has been effected in that comparatively short space of time is apparent to all. To-day we have in operation upwards of 100 miles of track (single), 270 electric cars, a generating station, two sub-stations, five engines and two turbines, 6,900 H.P. installed and 1,330 H.P. in progress, six car depôts and workshops, and a permanent way department, making a complete system entirely controlled by one committee through its own executive officers.

The constitution of a Tramways Committee is one of the most important factors in the success or otherwise of municipal operation. The number of members differs considerably in different corporations. My experience of both methods leads me, without any hesitation, to support the committee of smaller numbers, who are much more likely to form an independent judgment on the problems they have to deal with, and to work with a clearer understanding towards the success of the system as a whole, when unfettered by election promises to advocate the claims of some particular district.

Another point to be borne in mind is the rapid change which takes place in the *personnel* of the members of corporation committees. The average length of service of the present councillors on the Leeds Tramways Committee amounts to less than three years each, and since 1892 31 different councillors have had a share in the Committee's work. This fact appears to me to be a warning to committees against too hastily making changes in policy or embarking upon new schemes. Electric tramways have, perhaps, done more to relieve the congested and overcrowded districts of our great cities than any other recent reform. The danger of wholesale extensions, however, becomes apparent when, as is often the case, the financial success of the principal routes is used as an argument for the opening of fresh lines in every district of a town, regardless that some of them may run on roads parallel to those already installed. Here it is particularly that ward representation on the committee becomes most dangerous. I have heard of most extraordinary suggestions for extensions of this character; indeed, at one period there were persons in Leeds so intoxicated with the success of the tramways as to predict that in time we should have a tramway in every street in the city, and that all other forms of vehicular traffic would necessarily disappear. The numerous little "caves" that were formed by ward representatives for the purpose of getting additional routes in their respective districts made their applications exceedingly difficult to refuse, especially about election times. I cannot too strongly emphasise the stern necessity of every member of a tramways committee taking a broad and comprehensive view of the system as a whole, even if it should mean the sacrifice of some route for which his constituents may at the moment be agitating, and the consequent possibility of a loss of popularity and even votes.

We shall all agree in the advisability of having double lines wherever at all possible, both from the point of view of a quicker and more punctual service and the general convenience of other traffic. Double lines, however, in many cases involve street widenings, and the question as to whether the whole or any part of the cost of such widenings should be paid by the tramways department is one upon which general unanimity has so far failed to obtain. The Leeds Tramways Department has not as yet paid any direct contribution to the very large expenditure which has taken place in recent years in the widening of its streets. Powers to do so were sought by the Corporation in their Consolidation Bill of 1904-5, but Parliament, in its wisdom, saw fit to strike out the clauses in deference to the position of the railway companies, who feared that the application of tramway profits on this account might affect to some extent their rating liability. The attitude appears somewhat inconsistent when we remember that Parliament has in many cases laid upon private companies operating tramways in municipal areas, the obligation of paying the whole or part of street widenings on tramway routes, and, personally, I think that what is "sauce for the goose" ought also to be "sauce for the gander."

The question of intercommunication between tramways owned respectively by municipalities and by private companies by means of joint running powers over each other's lines is one that has agitated the tramway world very considerably during the past few years, and I am glad to see that a spirit of sweet reasonableness has developed generally; the idea once apparently prevalent in the municipal mind, that the permission for a company-owned tramcar to run on a municipally owned tramline would be intolerable at any price, has now practically disappeared. Many cases of such intercommunication are now well established with profit to both parties, and to the great convenience of the general public. We have a notable example of this in the amicable agreement arrived at between Leeds and the Wakefield Tramway Co., which has worked with absolute smoothness and freedom since its inception some 12 months ago.

The policy of every municipal tramway department must be so framed as to ensure its being entirely self-supporting. Philanthropy at the expense of the ratepayers must be rigidly avoided. The rates now obtaining on the Leeds system—viz., two miles for 1d. in every direction, with plenty of overlapping stages, so that the passenger may get his full value, and half-mile stages for ½d. on all routes except three (which may be described as high-class residential)—have been evolved from many experiments, almost all of them being in the nature of reductions or concessions. Our experience has been that high fares beyond a certain point reduce traffic; that every reduction has meant increased gross returns, whilst proper concessions popularise the service. The tendency to increase facilities and to lower fares below cost price for services rendered should be carefully watched by committees.

There is justification for giving all possible advantage to the long-distance riders, as this encourages the people to live at a greater distance from the centres of population. The policy of the committee should be to make their fares proportional on all sections. Special favours should not be granted to particular districts. It may be a selfish reason, but the exercise of a strict impartiality in this respect will save committees a lot of trouble. The policy, adopted by some municipalities, of the universal 1d. fare any distance may suit particular localities of limited areas, but if strictly maintained tends either to cramp further extensions or to cripple the finances.

Halfpenny fares for any distance over about half-a-mile are generally a mistake, but if kept within that limit may prove, as they have done in Leeds, fairly successful. Care should be taken not to stretch the length of the ½d. stages, as they immediately begin to encroach on the 1d. fares, with an adverse effect on the gross revenue. The ideal policy as regards fares may be summed up briefly: "Let each passenger pay for his ride, and receive full value for his money." This may appear a truism, but the rule is by no means universally observed. The London County Council is already carrying workmen at fares which are admittedly less than the cars can be operated for; the same is said to be true of the Metropolitan District Railway, which recently raised various fares, and is probably true of many municipalities, including Leeds. It appears to me that even workmen's fares at less than cost price are unfair to the rest of the inhabitants.

The necessity for reserve in addition to maintenance out of revenue is a burning topic on many committees. In Leeds a substantial sum has been set apart out of each year's profit to form a reserve for renewals and depreciation, and the balance of profit (averaging during the past five years about £54,000 per annum) applied in relief of rates. The reserve fund so accumulated now amounts to £118,500, representing nearly 10 per cent. on the capital expenditure, in addition to the sinking fund account, which now amounts to £175,200, making a total of the two funds £293,700, or about 22 per cent. on the capital expenditure.

The Council in 1904 obtained powers from Parliament to set aside a sum not to exceed at any one time a sum equal to one-fifth of the aggregate capital expenditure for the time being. We in Leeds are quite satisfied with the financial position of our undertaking, and consider it a sound policy for the ratepayers to receive some benefit in the relief of rates as interest on the capital employed, for which they as ratepayers are responsible.

As administrators, the committee naturally determine all questions of policy, whilst the executive function pertains to the office of the manager of the undertaking, whose duty it is to carry out the policy decided on by the committee. His work is likely to be much more effectively and economically performed if the policy of the committee be to have a completely self-contained department—*i.e.*, one in which the whole of the work of the department, including the supply of power and the responsibility for the permanent way, can be co-ordinated from one centre. That this contributes to a great saving of time and to the smoother working of the whole system we have proved by practical experience in Leeds, and that it tends to great economies in working costs can easily be seen by reference to statistics comparing costs of other places where this same happy condition is not carried out. The relations to a committee with its employés have been frequently used as an argument against municipal management of tramways on the ground of the alleged difficulty of making discipline effective. With a well-defined policy, however, this matter need not give any inconvenience. The general question of wages, length of working day or week, may be regarded as legitimate questions for discussion and settlement by the committee; but discipline must be ruled to be without the scope of policy—it is undoubtedly the duty of the executive—and the general manager must be held responsible by the committee for its proper maintenance. If the committee would resolutely decline to concern itself with this function, its work would be greatly simplified, its position would be strengthened, and under capable management the efficiency of the tramway service would be far greater than it could otherwise be.

Councillor Flint, of Leicester, opening the discussion on Mr. Smithson's paper, said one of the most important points raised by it was that as to the relationship of tramway committees and their employés. Seeing that the hours of the employés varied between 54 and 65 per week, and that the pay varied from 5d. to 7d. per hour, and there were all sorts of variations as to the question of Sunday labour and overtime, and the amount of holidays with pay allowed per annum, it was really necessary that a committee should be appointed to give consideration to these matters, not with a view to securing absolute uniformity, because that would be impracticable, but for the purpose of exchanging experiences which would be of great value to the Association and to all tramway committees. The trade union officials were going in for a levelling up, and he was sure that they would not be long in moving. In regard to the chairman's suggestion of arbitration, he heartily agreed with the principle; he thought that there was a good deal to learn from the experience of Halifax. He hoped that the executive would take into consideration the proposal for a committee which he had made.

Alderman Hay, of Halifax, stated that the cause of the strike in Halifax was a matter in the hands of the manager of the tramways, and the Committee did not consider it expedient to take that matter out of that gentleman's hands. They felt that it was not right that members of the Tramway Committee should go behind the manager in such matters.

Councillor Booth, of Reading, emphasised the need of paying attention to the reserve fund in dealing with tramway profits, and in illustration of the disadvantages of any other policy quoted the case of Swindon where an accident had necessitated the increase of the rates by 1s. in the pound. In regard to the labour question, he hoped that strong men would be put on the tramway committees who would deal with that question on businesslike lines; and he agreed that in matters of discipline the manager should be backed up absolutely by the Committee.

Bailie McFarlane held that at present tramway committees were too large, and the changes of *personnel* too frequent. He was entirely against ward representation on committees, and thought that there was no ground for the fear of intercommunication which was expressed in some quarters. The question of profit he regarded as one of the utmost importance. Could any of them say with assurance that there was any profit? He saw the importance of a large depreciation fund, and a large reserve fund. If they tried to yield a profit to the rates it was only regarded as a sort of windfall, and councillors set to work to devise means of spending it. He did not approve any contribution at all to the relief of rates.

Sir Baxter Ellis (Newcastle) said he regarded the question of the conditions of employment as a vital one; they were on the eve

of a great difficulty on that question. He described in detail the experience of the Newcastle Tramways Committee, and concluded by reminding tramway workers that if they tried to drive this matter up to the hilt, it would be such a blow to municipalisation in this country as they could hardly realise.

Councillor Littler, of West Ham, pressed the point that tramway managers must be allowed to have absolute control of their men; and, speaking of the tendency of corporations to pile burdens on the tramway committees, said these departments were treated as milch cows.

Councillor Monk, of Plymouth, congratulated the Leeds Tramway Committee on having control of its permanent way, and said that at Plymouth the control of the permanent way by another department was a constant source of trouble.

Alderman Wainwright, of Manchester, said that he did not see how they could federate themselves into one employers' union as it were; the conditions obtaining in London, for instance, were totally different from those in Manchester, Salford and Leeds. He would altogether object to the appointment of the Committee proposed by Councillor Flint. He strongly objected to ½d. fares, as shutting out the penny and twopenny passengers, and tending to prevent the spreading of the population, which was one of the objects of a tramway.

Councillor Fenton, of Sheffield, expressed the hope that even the appearance of combination to fight labour questions would be avoided. He spoke strongly in approval of the insistence on continuity of policy; all authorities should make a point of sticking to a good chairman when they had got one, quite regardless of his politics. They ought to consider whether they were willing to go on maintaining paving which was worn, not by them, but by others. The general arrangement in regard to paving was suited to the days of horse traction only.

Mr. Jas. McTaggart, of Aberdeen, said his council were troubled with ward representation, with the result that they had frequent demands for tramways for particular districts, in which it was practically certain that they would not pay. In Aberdeen they contributed nothing to the rates, and did not intend to do so until they had a very large reserve fund built up. His Council did not run their tramways over their own boundary, but allowed the suburban companies to run into Aberdeen. They gave these companies 3d. per car-mile, and collected all the fares themselves. They charged the suburban companies 2d. per unit for electricity, as against 1½d. charged against their own tramway department, which was supposed to be the actual cost.

Mr. George New, of Sunderland, complained of the great difficulty of getting men of ability and good business experience on to the Councils, which lay at the root of the difficulty in getting experts on the Tramway Committees. They were more troubled with conflicts between different sections of labour employed on the tramways, than with difficulties between the Tramway Committee and the workpeople.

The Mayor of Huddersfield mentioned the good effect of the appointment of a Conciliation Board in that town.

The President said they had never felt in that Association that they were in any way combined together for the purposes of interfering in any labour question. His intention in his reference to the labour questions was not to suggest more than that the Committee might appoint a sort of conciliation board in cases in which they were especially asked to do so by local authorities.

Mr. Smithson, in replying on the discussion, said that the only point of difference between him and those who had discussed the paper appeared to be on the question of halfpenny fares, and they might, perhaps, remember that he was not very strong on that matter. The labour question had been treated in quite a different way to that in which he had desired to approach it, and he also deprecated any appearance of a combination in that Association against the men.

Car Brakes.

Discussion on Mr. Mozley's Paper.

Mr. A. L. C. Fell said it was to be regretted that the author, reading a paper on "Brakes" in 1906 based on experiments made in December, 1903, should ignore all the improvements in magnetic brakes since the date of his test, and his final conclusions as to the respective values of brakes were not, therefore, in accord with those of engineers who had experimented on the more recent and perfected type of magnetic brake. It was a fact, in spite of the author's statement of its impossibility, that the new types of brakes could be and were used as a regular service brake on cars nearly as heavy as the Burnley cars, and on grades nearly if not quite as great, and it was also a fact that the service braking under these conditions did not necessarily burn out armatures; so far as his own experience with magnetic brakes was concerned, they were not uncertain in their action, and could not skid the wheels to a dangerous point. He admitted the necessity of distinguishing between two very different sets of conditions, such as those of Burnley and those of London, for example. Their object in London when choosing a brake for their cars was to find the best brake for London conditions, and the three qualifications kept constantly before them when making their choice were:—(1) Safety to the general public and the rolling stock of the L.C.C.; (2) higher average speeds without increasing the maximum running speed beyond a fixed limit; and (3) that the brake chosen should at all times be under perfect control. The necessity of the requirements under point (1) were self-evident. As regarded point (2), to fulfil these requirements quick application and quick release were a necessity, and the magnetic brake combined these qualities in a way which probably no other brake would ever more than equal. As regarded point (3), they found that with seven brake notches on the controller they were able to obtain extremely satisfactory results. Their lines in general were level, but they had some grades and were constructing additional lines which would probably have grades as severe as any at Burnley. A few of the grades upon which they were working had an incline of 1 in 10. With these facts in mind the results of their experiments brought to them a very different conclusion to that of the author of the paper, and he ventured to say that their conclusions, based upon experiments made with reliable instruments, were at least equally logical. The author made the statement that the magnets of the Newell magnetic brake would not hold a car on a 1 in 9·8 grade. This statement in itself was misleading, though probably true; the retarding action of the magnets on the rail were only a part of the total, inasmuch as it was impossible to use the Newell brake without applying the brake blocks to the wheels. If a retarding force of 4,113 lb. were applied through any type of brake, an 18-ton car, neglecting friction, would be in a state of running equilibrium. Any additional retarding force would eventually bring the car to rest. The brake shoes with which his experiments were made last year in London—and which his Committee adopted for the heavier types of cars—each had a pull on the rail, when about saturated, of 4,500 lb. There were four magnets under the car; therefore, the united pull on the rails in the vertical direction was 18,000 lb. The friction between the rails and the track shoes, they might safely take at 15 per cent.; therefore, the maximum retarding effect of the magnets alone was 2,700 lb. But the track magnets brought into effect the wheel brakes, and the leverage between the magnets and the wheel-brake blocks could easily be made in the proportion of 4, or even 5 to 1. Assuming 5 as the figure, then $2,700 \times 5 \times 15$ per cent. = 2,025 lb. which added to 2,700 from magnets alone = 4,725 lb. Therefore, without car friction, and without any torque of the armatures, the magnetic brake which they experimented with would stop a car weighing 18 tons, although it was only designed for a car of a maximum weight of 15 to 16 tons. If there was sufficient space between the braked-wheels in the 18-ton cars a still more powerful magnet could be utilised, and the leverage ratio also increased, thus increasing the retarding effect. From his experience he would say that cars could be, and were, handled with perfect safety on gradients such as those in Burnley with magnetic track brakes. But these should be used as service brakes. In their school they insisted on men learning to drive the cars with magnetic brakes before they learned with the hand brake, and they used it now as the service brake, and applied the hand brake only as a last resource. If they did not teach the men very carefully, they might, of course, apply the brake too fiercely. His aim had been to find a brake which could be instantaneously applied at any speed from 2 miles per hour to 25 miles per hour, and which could be made to stop a car in the shortest possible time on any grade. The conditions existing at Burnley, owing to the great length of the grade, were severe, and would require an extra output from the motors for a fairly long period of time, but experiments had indicated exactly what this extra work on the motors would amount to in a day's run, and they had made their selection of larger motors accordingly. It was, of course, understood that for service stops on level tracks the slipper brake described by the author was impossible, as it would be much inferior to the ordinary hand brake, which, in his opinion, was equally inferior to the magnetic brake. It was often overlooked, when dealing with the subject of brakes, that in all cases where the mechanical track brake was in use the retarding effect was limited by the weight of the car, multiplied by the coefficient of friction between the rail and the track shoes. This maximum possible retarding effect was practically the same whether it was all effected by the track brake or divided in any proportion between the track brake, wheel brake, and rheostatic brake. The author had described a method of operating his cars down the grade, which was most possible, and added the plain statement of fact that the method worked, and worked to his perfect satisfaction, but he spoke of the retardation produced by the brake blocks, hand-wheel brake, and rheostatic brake, as though they were in no way dependent upon each other, and as though they could all be exerted to their respective full powers at the same instant, which was manifestly impossible. He (Mr. Fell) submitted that, no matter what value was put upon the united braking effect of the three types of brakes, with the magnetic brake an additional braking effect of over 40 per cent. could be obtained. The figures were as follows:—(Assuming the same values as before) Weight of car = 40,320 lb.; assume coefficient of friction as 15 per cent. Then the maximum possible braking effect with the slipper, or combined slipper, wheel and rheostatic brake in retarding effect would be 6,048 lb. With the magnetic brake they could increase this maximum retarding effect by 2,700 lb., which was 44 per cent. increase. The following was also submitted for the author's consideration:—As previously shown, to bring his car to rest on the grade stated, and neglecting car friction, a retarding effect greater than 4,113 lb. must be applied. The author stated that two shoes only would safely control the car. They would naturally presume that he had tried this and was stating facts; but if they adhered to the figure for the coefficient of friction of 15 per cent., it was readily seen that unless more than one-half of the weight of the car could be applied to two of the track shoes, the car would continue to accelerate by a force equivalent to 2,097 lb. He admitted that 15 per cent. was a low coefficient to take, but even if they accepted a much higher one, it was readily seen that with only two of the shoes available there would be very little margin, if any. It must also be borne in mind that the maximum braking effect under these conditions could be obtained only by taking the entire weight of one-half of

the car on the shoes, and this was a bad condition in which to place a car which might have a curve to negotiate at the foot of the grade. He could not reconcile the author's statement that "for an emergency stop the rheostatic brake is used, and its effect is very efficient and will stop a car at 6 miles per hour on 1 in 9·8 in 3 or 4 yards," with his general assumption that the whole arrangement was made useless if, instead of wasting the energy generated by the motor, as in the rheostatic brake, it was used for magnetising supplementary track brake shoes. Tramway engineers had given this question most careful consideration, and the fact that the magnetic brake was in operation on over 3,000 cars at the present moment showed that, although a few antiquated sets failed in Burnley some years ago, a large number of engineers were prepared to pin their faith on the efficiency of the latest developments. It must also be borne in mind that very few cars fitted with magnetic brakes had met with serious accidents.

Mr. Nance (Belfast) said he had had to come to a conclusion as to which brake to operate, and the first element in his calculation was that no brake was independent of the human element, and that if the motorman was stupid or careless or nervous, it did not matter how perfect the appliances of his car were. Indeed, it was possible that the more perfect his appliances were, the less likely he would be to use them, or to remember how to use them. He could not imagine anything superior to the hand brake as a service brake. With regard to emergency, he thought the rheostatic brake satisfied every requirement. He adopted the mechanical slipper brake for the track brake, because he felt most comfortable with it. The great virtue in this, to his mind, was that they could use it all the time, and both the driver and the conductor could put it on. In Belfast at the top of every down grade of any importance the motorman was bound to stop the car and put the slipper brake on sufficiently to allow the car to run at the proper speed. As the motorman on every car used his slipper brake constantly, he had not the slightest doubt as to how he should apply it if an emergency arose. On one of the gradients not only had the car to be brought to a stand at the top, but it had to be stopped three times on the way down, whether there were passengers or not. A good thing was to pay careful attention to keeping the sand very dry. In Belfast, so far, there had not been the slightest sign of a runaway, though some of the gradients were very stiff. In regard to the magnetic brake, in two out of the last three bad accidents, the cars were fitted with such brakes, and, in their terror, the drivers did not seem to have known how to use them. He unhesitatingly gave his judgment in favour of the mechanical slipper brake.

Mr. Aldworth (Nottingham) said he was working on gradients of 1 in 11, and below that, with mechanical slipper brakes, and had carried very large numbers of passengers without a single runaway car or accident.

Mr. Yarborough (Sheffield) asked whether Mr. Mozley had ever carried out an experiment with energising the magnetic track brake from the trolley wire. It appeared to him that good results might be obtained in that way.

Mr. Clough (Bury) expressed great regret that Mr. Mozley had based his conclusions on tests made three years ago, and with magnetic brakes which had now been superseded. Mr. Mozley's figures, in his judgment, were vitiated by the manner in which they had been arrived at. He himself had 40 cars fitted with magnetic brakes, and he had not had the slightest experience of the burning out of the armatures, which Mr. Mozley referred to. Mr. Fell had shown by his tests that the magnetic brake would only increase the temperature of the motors 1½ per cent., whereas the increase of temperature with the rheostatic brake was 25 per cent. The rheostatic brake as an emergency brake was, in his opinion, most unreliable. The hand brake had proved more reliable and effective than the rheostatic brake in some tests. His experience was that the motorman at once reverted to the hand brake when the rails became greasy. He held that the track brake recommended by Mr. Mozley could not be used for emergency; and that Mr. Mozley was bolstering up the case for that brake by recommending the use of the highly destructive rheostatic brake. With regard to conclusion No. 3 at the end of the paper, Mr. Mozley did not show anywhere in the paper how he arrived at that conclusion.

Mr. Spencer (Halifax) said that he did not think he was in favour of the magnetic brake unless it could be worked from the trolley wire. But in the case of the recent accident at Halifax it was shown conclusively that the motorman had not used the brake-power that was at his disposal, and that was the crux of the matter. He thought that the hand and slipper brakes were sufficient to deal with any gradient in the country, but if a brake could be devised which got its current from the trolley wire and acted as an auxiliary to the slipper brake, it would certainly be an advantage.

Mr. Fenton (Sheffield) said the general tendency was to increase the speed of running, and the all-important question appeared to him to be, What was the type of brake the use of which would lead the Board of Trade to allow an increase of speed? He remembered, in this connection, that the result of the trials in London by Mr. Fell was that the Board of Trade had increased the speed by as much as 40 per cent. Could Mr. Mozley say that such an increase would be sanctioned by the Board of Trade if tramway managers acted upon his conclusions in regard to the choice of brakes?

Mr. C. J. Spencer (Bradford) said that, though much could be said in favour of the magnetic brakes, it was unfortunate that the car had to attain a certain definite speed before it was known that it was out of order, and the temptation was to allow the car to travel just a little bit faster than it should, just to see whether it would act. In his opinion, this had been the cause of some of the accidents with magnetic brakes. The principle underlying the action of magnetic brakes seemed to him to be ideal. To get the whole of the necessary friction for retarding the car direct between the moving car and the stationary rail, without in any way interfering with the weight of the car itself on the wheels, was a very great advance, but the danger was in using the motors as the source of energy. If some separate supplier of current could be found, as apart from the motors being used as generators, that would be a very large stride towards solving this great problem. But the idea of using the trolley wire for current suggested to his mind some serious disadvantages. He thought that Mr. Mozley had touched new and rather valuable ground in his reference to the use of cast-iron as compared with wood blocks for slipper brakes. Wood blocks had served in Bradford very well for some years, but the complaint was that the constant renewals made them very expensive If it were found that cast-iron would do as well, the maintenance would certainly come down, providing the track was not worn. An experimental car had been fitted with cast-iron blocks at Bradford, and he was disposed to think that there was a good future before the cast-iron block.

Mr. Mozley, replying to the discussion, complained that if Mr. Fell was going to read a paper as he had done, it should have been printed and circulated, as his own had been. He had no personal feeling at all against the magnetic brake, but in Burnley they had been bound to give it up. As to wood blocks, they had found them quite useless on a greasy rail, whilst with cast-iron blocks the braking was perfect. The readings of volts and amperes which he had given were taken by the greatest experts in this country, and there was no doubt about the figures being correct. He would like to see corresponding figures given by Mr. Fell, from whose paper they had been entirely absent. In reply to Mr. Fenton, he might say that they had just obtained from the Board of Trade permission to increase their speed to 12 miles an hour, which was the maximum fixed for them by the Act of Parliament.

At this point the Conference adjourned until Thursday.

The Dinner.

In the evening the Corporation of Leeds entertained the Association to dinner in the Victoria Hall, the Lord Mayor presiding over a large assembly, which also included influential local ladies and gentlemen. Sir Jas. Kitson, Bart., M.P., the Hon. Arthur Stanley, M.P., Sir J. Baxter Ellis (Lord Mayor of Newcastle), and Sir John Ward (chairman of the Leeds Tramway Committee), Alderman E. Broadbent (Mayor of Huddersfield), the president of the Association (Mr. J. B Hamilton), and Alderman F. Smith (of Liverpool), were the chief speakers.

The Business Meeting.

The usual business meeting was held on Thursday morning at the commencement of the day's proceedings, the President (Mr. J. B. Hamilton, of Leeds) again occupying the chair. The meeting was held in strict privacy so far as the Press was concerned.

The report presented by the Executive Committee contained the following reference to the question of amalgamation:—"The Committee have during the year further considered the question of the widening of the basis of the Association, and they are still of the opinion that it is desirable, in the general interests of the tramway industry, that there should be one powerful and widely representative Association for the whole country; but, in view of the many expressions of opinion which have been conveyed to them as to the danger of subordinating or jeopardising municipal interests, they recommend that 12 corporation representatives (chairmen or vice-chairmen of committees) be appointed to confer with the Executive Committee, with a view to their reporting as to whether or not the constitution can be so framed as to grant wider representation on the Association, and yet at the same time thoroughly conserve and safeguard municipal interests."

We are officially informed that this recommendation was submitted to the business meeting, and after full consideration of the whole subject, a resolution was adopted to the effect that the thanks of the Association were tendered to the Executive Committee for their consideration and report in regard to this matter, but the members deemed it inadvisable to proceed further with the matter.

The treasurer's report was submitted, and showed a balance of £92 odd.

The President moved the election of Mr. J. M. McElroy as his successor in the chair. He stated that Mr. McElroy, who had done such valuable service as secretary and treasurer for the past five years, had desired to resign his position, and the council had agreed that he should be allowed to do so on the condition that he should accept the presidency. The resolution was carried unanimously, and Mr. McElroy responded in suitable terms.

Mr. J. Aldworth, of Nottingham, was elected vice-president, and Mr. A. R. Fearnley, of Sheffield, secretary of the Association.

The three vacancies on the Executive Committee were filled by ballot by the re-election of Mr. A. Ellis (of Cardiff), and the election of Alderman Wainwright (Manchester), and Mr. J. Lancaster (Blackpool). Mr. H. Mozley was elected auditor.

Annfield Plain Lighting.—The U.D.C. has engaged Messrs. D. Balfour & Sons, of Newcastle, to advise on the question of the Council undertaking an E.L. scheme.

THE OUTLOOK FOR BRAZILIAN TRADE.

The number of the New York *Electrical World* to hand by this mail contains a reprint of a report which has been prepared by Mr. W. J. Johnston (whose connection with the *Electrical World* in its earlier years some of our readers may remember) on the trade conditions in Brazil, and the opportunities for doing *American* business there. Mr. Johnston, who is now running the *American Exporter*, recently travelled in South America in company with Secretary Root, and the present observations are one outcome of that tour. We have already published in our series of articles on "Neutral Markets of the World" a good deal of information concerning Brazilian trade, and we print the present report in order that British electrical houses may be in possession of all information of value—though not written expressly from their own point of view—to guide them in the development of their plans for dealing with this market. We quote:—

"There is undoubtedly a large market in Brazil for manufactured articles from the United States—machinery, hardware, novelties, agricultural implements, automobiles and other vehicles, typewriters, shoes, textiles, drugs and proprietary medicines, food preparations and beverages, perfumes, paints, oils and varnishes, furniture, roofing, clocks and watches, steam and electrical specialties and the like. Manufacturers of such articles are probably more interested in some practical suggestions as to how they can market their products in Brazil than in an essay treating of the general commercial situation.

"To begin with, the fact should be borne in mind that the conditions all favour a large trade between the United States and Brazil. The United States is Brazil's best market, taking more than half of her entire exports. We admit free of duty her coffee (to the extent in 1905 of $64,136,008), her india-rubber ($28,476,252), her cacao ($1,238,859), her hides and skins ($2,364,207 free, besides $507,936 dutiable), her manganese ore and oxide of manganese ($990,044), making with other articles a total of 1905 free of duty of $97,966,274. It will thus readily be seen how seriously the prosperity of Brazil would be affected were we, for example, to impose even a small tax on her coffee.

"The important special concessions recently made by Brazil in favour of certain lines of American goods and the answer which Brazil has made to other countries, which objected to the preferential arrangement with us, and which claimed equal privileges (under the favoured nations' clause in their treaties), demonstrated that the statesmen of Brazil appreciate the situation. They frankly point out to these other countries that the commercial relations existing between the United States and Brazil are unique, and that this is the reason why the special advantage is given to the United States.

"It is considered not unlikely that rebates will be made from time to time on other lines of American manufactures; in fact, American exporters may be able to secure additional concessions if they will only present the matter forcefully before the State Department. Secretary Root takes more than the ordinary patriotic interest in the extension of American foreign trade. He is now personally known to, and highly esteemed by, Brazilian officials. Never before have the Brazilians received a foreigner with such marked attention. A request later from the State Department is likely to receive careful consideration. If American manufacturers do not get further tariff advantages in Brazil the fault will be entirely their own.

"The merchants of Brazil complain that while their customers demand and they are anxious to handle American goods, they are handicapped by the fact that the manufacturers of the United States insist on spot cash payments while they themselves can only sell their goods by giving their customers extended credit. True, they get liberal interest—usually 12 per cent., but as German and British manufacturers make no objection to giving credit, American manufacturers certainly lose many orders by not following the practice of other nations in this respect. Even where a Brazilian is able to pay cash, he resents as a personal slight insistence upon prompt payments. The Brazilian prides himself upon keeping his financial obligations and comparatively little is lost in bad debts.

"Manufacturers of the United States who are in a position to grant credits, and who wish to do something approaching the maximum business open to them in South America, may find, on investigation, that the risk involved is less than they have imagined. In nine cases out of ten when I ask a merchant what American manufacturers should do to increase their volume of trade in Brazil, the matter of credits is what he mentions first.

"Dealers complain, too, that while the first letter they receive from an American manufacturer usually gives promise of opening up satisfactory business relations, the second one, in answer to their inquiry for prices and terms is so full of restrictions and an apparent lack of confidence in their commercial honesty that hope of inaugurating a business connection vanishes.

"Germans are doing much of the business in Brazil that was formerly carried on by British manufacturers. This is due, primarily, to the fact that the German salesman is particularly well equipped in business training, languages and adaptability to secure the confidence of the Brazilians; and secondly, to the fact that German houses will modify their goods to meet the special Brazilian requirements. At the same time, German goods are not well thought of in Brazil, and where the proper effort is made American goods will always sell in preference to German goods, even at a considerably higher price. For example, nine-tenths of all the electrical machinery in Brazil is American."

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

20,070. "Improved electrical safety lamp." A. Edelmann and N. A. Wallin. September 10th.

20,113. "Improvements in or relating to surface contact electric traction systems." E. A. Mitchell and H. Lubbock. September 10th.

20,114. "Improvements in or relating to surface contact electric traction systems." E. A. Mitchell and H. Lubbock. September 10th.

20,115. "Improvements in telegraphic apparatus." C. E. Yetman. September 10th.

20,130. "Improvements in electric current collecting trolleys." H. J. Haddan. (J. A. Caldwell, United States.) September 10th. (Complete.)

20,131. "Improvements in connection with telegraphic or secret codes." B. McNeill. September 10th.

20,132. "Electric burglar-alarm system." E. A. Prevette. Septembe 11th.

20,201. "Improvements in or relating to electric switches." The Electric Ignition Co., Ltd., and F. H. Hall. September 11th.

20,209. "Improvements in or relating to metallic glow-bodies for electrical apparatus." A. Lederer. September 11th.

20,210. "Improvements in supports for metallic glow filaments." A. Lederer. September 11th.

20,231. "Improvements in or relating to electric-current collecting trolleys." J. T. Haudenshield. September 11th. (Complete.)

20,233. "Improvements in single-phase alternating-current electric machines." Felten & Guilleaume-Lahmeyer-werke Act.-Ges. (Date applied for under Patents Act, 1901, October 2nd, 1905, being date of application in Germany.) September 11th. (Complete.)

20,235. "Improvements in mercury vapour or like electric lamps." L. A. Audibert. (Date applied for under Patents Act, 1901, September 20th, 1905, being date of application in France.) September 11th. (Complete.)

20,294. "Improvements in electric incandescence lamps suitable for theatrical, decorative and other purposes." W. J. Crawshaw and R. Affleck. September 12th.

20,297. "Improvements in electric dynamo-motors for use on motor road vehicles and various other purposes." F. S. Coles. September 12th.

20,327. "Improved method of operation with lead-peroxide-zinc storage batteries." R. Ziegenberg. September 12th.

20,328. "Improvements in the process of charging lead-peroxide-zinc storage batteries." R. Ziegenberg. September 12th.

20,332. "Method of ascertaining the comparative power of X-rays, high frequency rays and the like, and apparatus therefor." W. P. Perry. Septempter 12th.

20,369. "Improvements in or relating to switches for use in electric circuits." F. Broadbent. September 13th.

20,370. "Improvements in galvanic batteries." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) September 13th. (Complete.)

20,380. "Improvements in electrolytes for the electro-deposition of copper." S. O. Cowper-Coles. September 13th.

20,393. "Improvements in and relating to protective systems for electric supply conductors especially applicable to electric railways and the like." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 13th.

20,395. "Improvements in and relating to electric transformers and the like." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 13th.

20,396. "Improvements in and relating to electric transformers, reactances and the like." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 13th.

20,398. "Improvements in electric batteries." The A.B.P. Accumulator Co., Ltd., and T. P. Barker. September 13th. (Complete.)

20,399. "Improved form of galvanoscope, galvanometer, or single-needle instrument." W. Powles and E. E. Moore. September 13th.

20,416. "Improvements for regulating the excitation of dynamos and motors with special reference to variable speed generators." P. L. R. Fraser. September 14th.

20,442. "Improvements in electric drills." E. M. T. Boddam. September 14th.

20,450. "Improvements in and connected with commutator bars for dynamo-electric and like machines, and in the method of fastening the armature coil connectors to such bars." B. Elshoff. (Date applied for under Patents Act, 1901, September 14th, 1905, being date of application in United States.) September 14th. (Complete.)

20,462. "Improvements in electric heaters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 14th.

20,463. "Improvements in and relating to electric arc lamps." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Gesellschaft.) September 14th.

20,464. "Improvements in and relating to the control of electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 14th.

20,472. "Apparatus for altering the self-induction in alternating current circuits." J. W. Mackenzie. (The firm of C. Lorenz, Germany.) September 14th. (Complete.)

20,490. "Improvements in the manufacture of shade holders, shade fittings, lamp or globe holders for lamps, electric lights, gas, candle and such like fittings." J. Hinks & Son, Ltd., and S. H. Brittain. September 15th.

20,513. "Life-guard for electric tramcars." G. T. Jorden. September 15th.

20,545. "Process and apparatus for the separation of substances having different magnetic excitabilities with the use of crossing conveying devices." The Corporations Maschinenbau Anstalt Humboldt and Metallurgische Gesellschaft. (Date applied for under Patents Act, 1901, January 26th, 1906, being date of application in Germany.) September 15th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

Means and Apparatus for Temporarily Producing Alternating Currents in an Electric Circuit at one or more Optional Points of the Circuit and the Application thereof to the Working of Printing Telegraph Apparatus. Siemens & Halske Akt. Ges. (Date applied for under International Convention, March 21st, 1905.) 4,813. February 27th.

Regulation of Enclosed Arc Lamps. J. Brockie. 6,300. March 15th.

Alternating Current Arc Lamps. The firm Ehrich & Graetz. (Date applied for under International Convention, September 6th, 1905.) 6,532. March 20th.